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British Journal of Anæsthesia

VOL XVIII No 3

JANUARY, 1943

A NEW CIRCLE TYPE CARBON DIOXIDE ABSORBER

BY

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OVER two years ago Messrs Coxeter and Son Ltd showed me an experimental model of a carbon dioxide absorber with ether vaporiser, possessing some interesting features, which were capable of improvement from the anæsthetist's point of view. As a result of our discussions certain essential requirements and other desirable, if not essential, features were agreed. In due course a new design based on this specification was produced and laboratory tests on an experimental model were made. These results were so encouraging that a clinical trial was made which confirmed in use the laboratory results.

The requirements agreed, the manner in which they were met, laboratory and clinical tests, are described below.

(A) ANÆSTHETIC REQUIREMENTS

1 The prime function of a carbon dioxide absorber is, of course, to absorb carbon dioxide from the patient's expira-

tions, and this absorption must be as great as possible so that the inspired gases shall contain a minimum quantity of carbon dioxide. Occasionally, however, it may be desirable to build up low concentrations of carbon dioxide in the gases, and for this purpose fractional absorption should be possible, i.e. the diversion of a portion only of the expired gases through the soda-lime.

2 It should have a soda-lime "cut-out" so that the soda-lime can be changed without opening the circuit, thus minimising the loss of valuable gas if such is being used, and avoiding alteration of the anæsthetic mixture, thus making for economy and smoothness of anæsthesia.

3 It should have a reservoir bag big enough to supply sufficient gas for the largest inspiration that a patient is likely to make.

4 The resistance to respiration should be as low as possible. This implies that the uni-directional valves must lift with the least difference of pressure so that the resistance offered by them shall be a minimum and that the path of the gases through the breathing tubes, and the ether and soda-lime chambers, is unrestricted.

5 An ether vaporiser should be incorporated in the circuit so that ether vapour can be added to the gases, if desired. This vaporiser should be of high efficiency, wickless, so that water-laden gauze is avoided, and so constructed that temperature drop is minimal.

6 The slightest movement of the bag should be easily visible, magnified, if possible, by mechanical transmission to an indicator. Any mechanism attached to the bag should be so balanced that no effort is required to fill the bag.

7 A mechanical method of compression of the bag should be available so that the patient's chest can be inflated at will, and controlled respiration be possible without undue fatigue on the part of the anæsthetist.

8 The whole apparatus should be gas tight so that at least leakage from the machine is eliminated.

9 There should be some audible means of knowing how far the controls are being turned when using the apparatus in a dark room.

10 The "dead" space should be minimal, i.e. the circle

should be brought as near the patient's lips as possible. This problem, though being attacked, has not yet been satisfactorily solved, and in the apparatus to be described the conventional method of attaching the two breathing tubes to a face piece or endotracheal catheter has been retained.

11 There should be a means of adding atmospheric air to the gases in the circuit.

12 There should be an expiratory valve on the machine which can either be completely closed or opened so as to work with a minimal difference of pressure.

13 There should be an inspiratory valve on the machine through which air can be inspired if the system becomes inadvertently empty, or deliberately should the anaesthetist desire the patient to do so.

14 There should be a means of indication of the time the soda-lime has been in use.

(B) MECHANICAL REQUIREMENTS

1 The apparatus should be robust and able to withstand average wear in an operating theatre for a long period of time, without lowering its efficiency.

2 It should have as few joints as possible to eliminate gas leakage. As much as possible of the apparatus should be cast in one piece, and such joints as are necessary should be screwed or welded rather than taper jointed.

3 Moving drums should be gas tight and be easily removable for cleaning and lubrication.

4 Provision should be made for the drainage or removal of condensed water.

5 The controls should be clearly labelled and seen and be easy to work.

6 The apparatus should be as light in weight as is consistent with anaesthetic requirements and robustness. Unfortunately in time of war the choice of materials is limited, and lightness of weight has had to be subordinated to availability of material.

7 The minimum amount of rubber should be used in the apparatus, and wherever rubber is used it should be capable of easy replacement should it perish. By avoiding rubber,

gas loss by diffusion through this material—a most important and little appreciated fact—is minimised

8 The valves should be, and remain, efficient for long periods of time. In the case of gravity valves, the valve itself should not warp

(C) CHEMICAL AND PHYSICAL REQUIREMENTS

1 The materials used in the construction of the absorber should not be liable to corrosion by ether, soda-lime, water, or any other chemical agent likely to be found in anaesthetic mixtures

2 The ether vaporiser should be such that cooling of the ether is reduced as much as possible and water heaters avoided. Easy filling, wickless vaporisation and fine graduation of vapour are also desirable

3 The clinical point of exhaustion of the soda-lime should be shown by some simple means, preferably visual. However, chemical endpoint and clinical endpoint do not coincide, and colour change detection for clinical soda-lime exhaustion is still in the experimental stage. The patient is still the most important guide to soda-lime exhaustion

4 The whole apparatus should be earthed, and the tubing to the patient be conductive, to minimise explosion due to static electricity

(D) AESTHETIC REQUIREMENTS

1 If it is at all possible, the apparatus, while conforming to all the above requirements, should by its symmetry and colour be pleasing to the eye and harmonise with the rest of the theatre furniture

A recent effort to try and incorporate some of these requirements in an absorber was made by Frankis T Evans (*Lancet*, 1938) whose admirable machine then represented a real advance in absorber design. However, his observations on the difference between single- and double-phase absorption in the circle type of machine have not been confirmed in experiments with this present machine. We, on the contrary, have found more efficient absorption to take place when both inspirations and expirations pass through the soda-lime

The circle type absorber which will now be described was intended specifically to be attached to the table of the standard "Boyle" machine supplied by the Emergency Medical Service

THE CIRCUIT

The circuit arrangement is as shown in Fig 1. The patient's expirations pass through the soda-lime into the bag, and the gas which he inspires comes from the bag, back through the soda-lime, so that a "to and fro" system remote from the patient is employed, and the advantages of both the "to and fro" and the "circle" type absorber are retained. This type of circuit was experimented with by Frankis T Evans (1938), but success was not, apparently, obtained. Evans found that though with single-phase absorption in his machine the CO_2 fell to 0.5 per cent or less, with double-phase absorption it rose to 4 per cent. In the present machine an

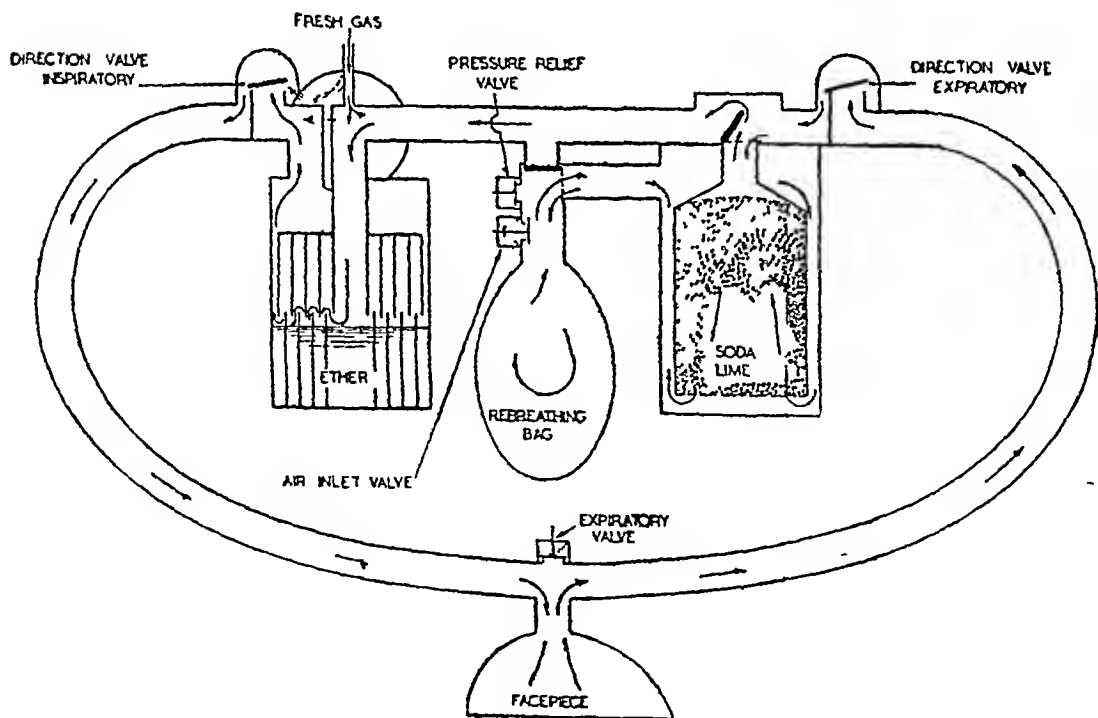


FIG 1

Circuit diagram Soda-lime and ether both "on"

alternative drum was made which converted the circuit into the conventional single-phase system (i.e. one in which the expirations only pass through the soda-lime) and the carbon dioxide content of the inspired gases was estimated. The best figures were obtained when both inspirations and expirations passed through the soda-lime (See Fig 2)

SODA-LIME

The soda-lime (Wilson 4-8 mesh) is contained in a canister of almost standard dimensions (13.07 cm × 7.4 cm). It has a simple plug-in mount with a bayonet catch to lock the taper

ABSORPTION EFFICIENCY TEST
COMPARISON OF ONCE & TWICE THROUGH SODA LIME
CONDITIONS IN BOTH CASES - 150 CC CO₂ INLET FLOW
- 500 CC TIDA VOLUME
- 19 RESPIRATIONS/MIN

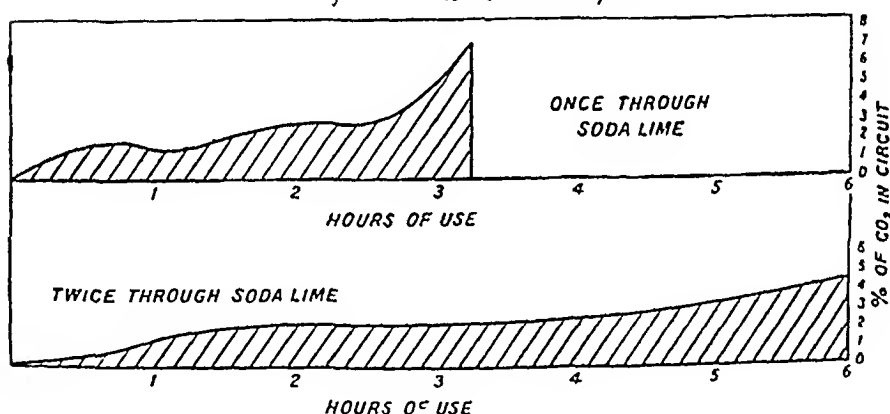


FIG 2

Absorption efficiency tests, comparing single and double phase absorption

in place. The soda-lime canister is surrounded by an outer cover which conveys the gases back to the bag, and this outer cover is easily removable by swinging aside a sling for the purpose of changing the soda-lime. The capacity of the soda-lime canister is 568 cc empty, and it holds 1 lb (453 grams) soda-lime. The air space between the granules when the canister is full is 426 cc. A series of laboratory experiments were performed in which the carbon dioxide content of the gases near the face-piece was estimated when the circuit was used under a variety of conditions simulating those in clinical

practice These experiments were stimulated by the excellent paper by Adriani and Rovenstine (*Anesthesiology*, Jan 1941) to whom the author is much indebted Two methods were used for estimating the carbon dioxide a modified Orsat method with caustic potash as the absorbent, and

ABSORPTION EFFICIENCY TEST

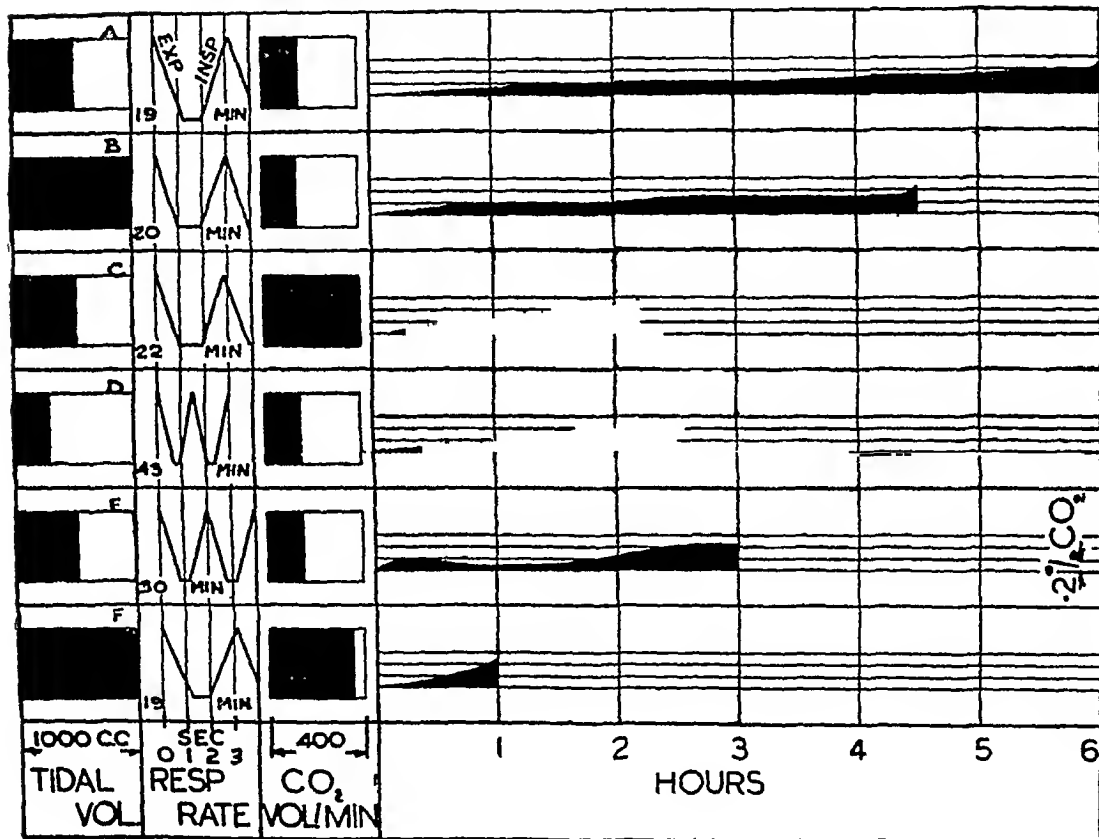


FIG 3

Absorption efficiency tests under variety of conditions

Pettenkofer's method, using Baryta Better absorption was obtained with double-phase absorption (i.e. inspirations and expirations passing through the soda-lime) than with single-phase absorption The results obtained compared most favourably with those shown in Adriani and Rovenstine's paper, and are shown in Fig 2 and Fig 3

RESERVOIR BAG

In order to allow of easy manual compression of the bag for the purpose of artificial respiration or controlled respiration, the bag is of concertina shape (Fig 9) It is attached at one end to the body of the absorber, and at the other to a back plate, which is directly connected to a lever ending in a conveniently placed knob on the front of the machine. Depression of this knob compresses the bag with little effort on the part of the anaesthetist. The lever system is carefully

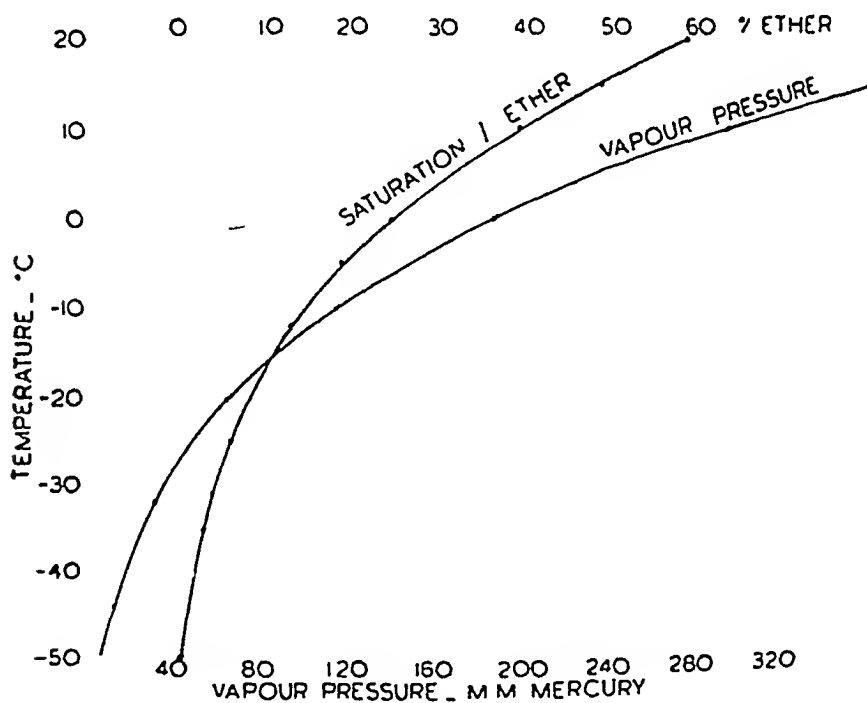


FIG 4

Ether saturation and vapour pressure curves

balanced on ball bearings, so that the bag moves with the slightest respiratory effort. Each corrugation of the bag is stiffened by a wire ring, preventing collapse. The movement of the bag is transmitted to the knob, and can be watched from the front of the machine. The capacity of the bag without distension is $2\frac{1}{2}$ litres, and is, therefore, large enough to supply the largest inspiration likely to be met with

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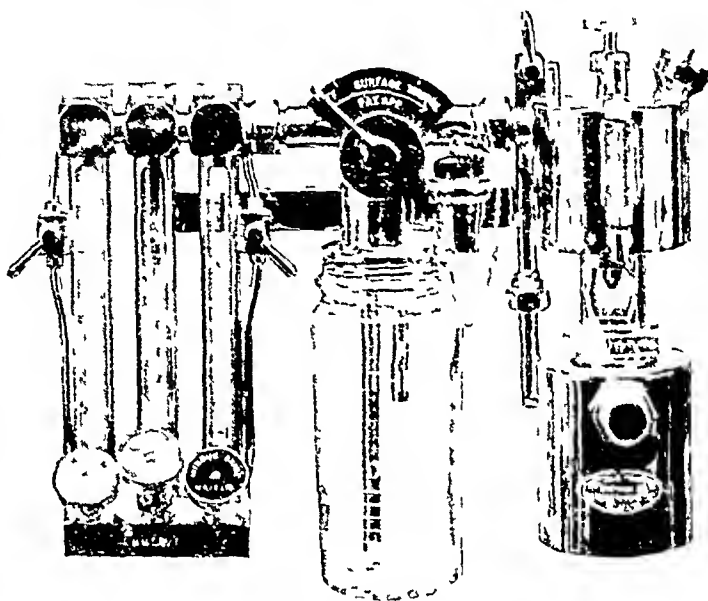
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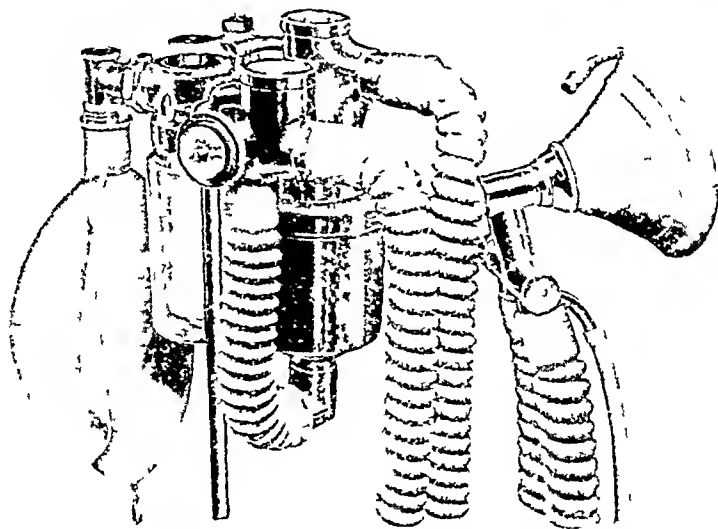
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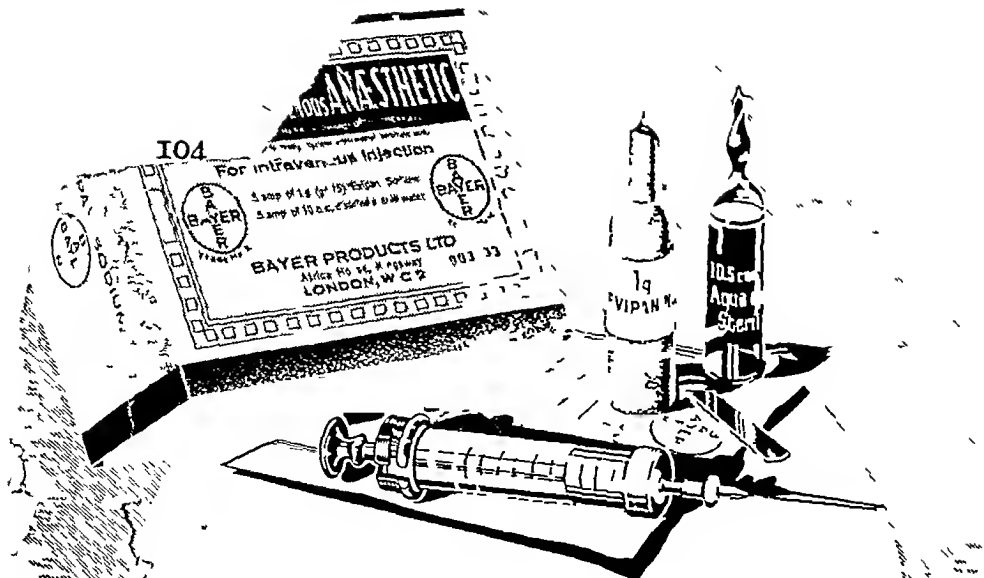


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in practice Should the bag become defective, an emergency repair can be made by removing the concertina bag and plugging in an ordinary one-gallon thin rubber bag on a standard mount (See Fig 6)

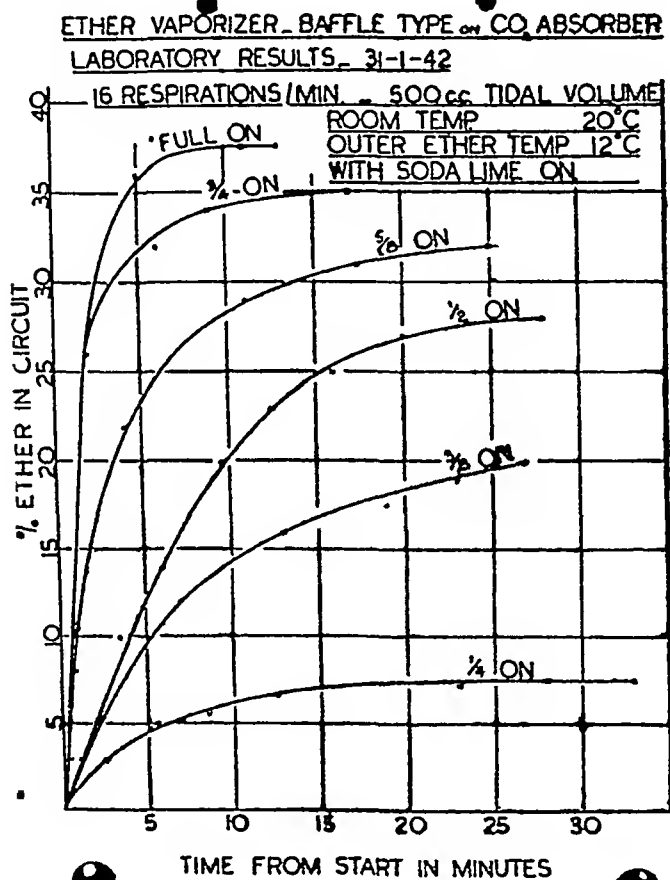


FIG 5
Curves of ether concentration

ETHER VAPORISER

The main requirements of an ether vaporiser for a circle type absorber are

- (a) That the restriction to breathing is minimal

(b) That ether can be added gradually to the circuit from a minimal amount, to at least a maximum sufficient for the deepest anaesthesia

(c) That evaporation of ether is rapid, and that it is capable of maintaining the ether concentration in the circuit at a constant level for periods extending into hours

In most of the present methods of vaporising ether, the gases are passed through or over ether-soaked gauze, which must be of some thickness to provide a sufficiently rapid evaporation. Not only may the resistance to breathing by this means be increased, but the gauze rapidly becomes saturated with water vapour, which is condensed as the temperature falls. This lowers its efficiency, and still further increases the resistance to breathing. Ether cools as it vaporises, and as it cools the vaporisation becomes less (Fig. 4). The ether containers in present use are usually made of glass—a poor conductor of heat, and when rapid vaporisation of the ether is required the temperature falls sharply, with a coincident falling off of vapour strength. The ether vaporiser fitted in this absorber has no wick, and the humidity of the circulating gases does not affect its efficiency. In order to ensure that the gases come in contact with the warmest part of the ether before leaving the vaporiser, evaporation is made to take place in successive stages. The gases impinge on to the surface of the ether at the centre of a concentric nest of baffles, and at this point the maximum evaporation takes place. It is at this point, therefore, that the ether temperature suffers the greatest drop. At each successive impingement less ether is picked up as the gases become more and more saturated, and the temperature drop is therefore less.

Finally, before leaving the vaporiser the gases come in contact with the outer layer of ether which, being in contact with the container (made of copper for maximum heat conduction), is maintained at room temperature.

The baffles, like the rest of the vaporiser, are made of copper, and they also act as heat conductors from the main body of the machine, and in the case of the second innermost baffle from the container itself, and therefore from the air of the theatre. In a room at 65°–70°F (average operating

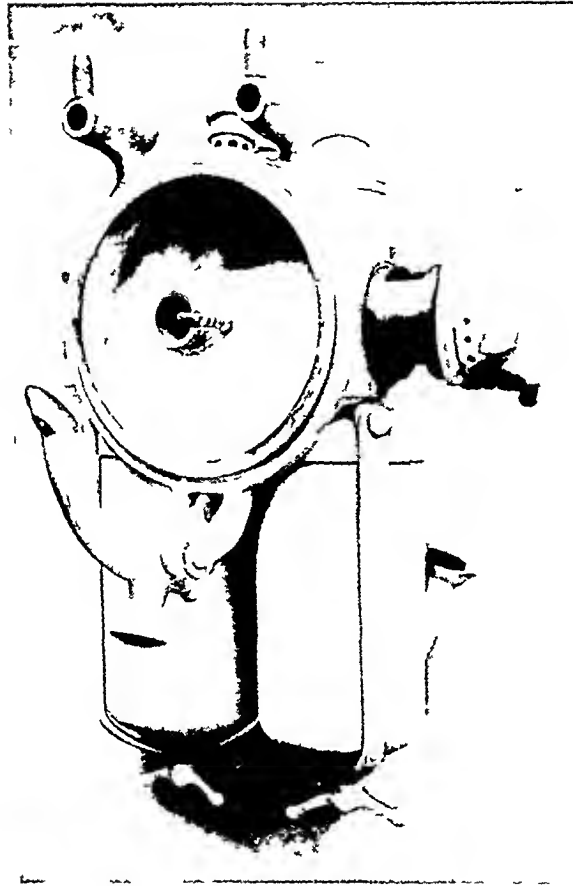


FIG 6
View of back of absorber with bag off

W W M

theatre) evaporation of the ether takes place very quickly in this vaporiser with only a slight drop in the temperature of the ether. This ether vaporiser thus overcomes the moisture difficulty, causes a negligible resistance to breathing, and allows a continuous evaporation of ether with little drop in temperature. The vaporiser was constructed so as to be symmetrical with the soda-lime canister in size. Being made of copper, it must have an indicator to show the amount of ether within. An ether level gauge is fitted which indicates the ether level down to zero. The vessel should always be filled through the filler provided, which is so arranged that too much ether cannot be poured in (maximum amount is 13 fluid oz). The ether concentration obtained and the degrees of control are well illustrated by the graph of experimental laboratory results shown in Fig 5. In these experiments the gases were circulated from the apparatus into and out of a simple rubber bag. If there were no loss of ether from the system each curve should eventually rise to saturation percentage. Rubber, however, allows ether vapour to diffuse fairly freely, and as a consequence there is a continuous loss of ether from the system. The results, therefore, approximate to actual clinical conditions where, in addition to the loss through rubber, ether is lost by the patient through his skin and the operation wound. The method of removing the ether chamber from the machine for cleaning purposes is by swinging aside a sling in the same way as for the soda-lime canister. The ether vaporiser is fitted on the inspiratory side of the circuit. Turning off the ether diverts the basal O_2 flow from the machine side to the patient's side of the inspiratory directional valves. (See Fig 10.)

CONTROLS

The large, easily grasped control knobs for the ether and soda-lime are placed symmetrically on either side of the machine. These turn large drums which can be removed easily for cleansing and lubrication. Both the ether and the soda-lime can be used in a fractional manner, and a loud click is heard and felt at the $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ marks, so that indication other than visual is given to the anaesthetist. The main body of the machine, to which is attached the bag and the

ether and soda-lime chambers, is cast in one piece, with the channels for the rotating drums running through it. Mounted on this body are two glass domes through which the unidirectional valves can be seen. These valves are of the conventional gravity type, but being made of compressed fibre (Scolam) of half the density of aluminium they can be made thicker, and with less likelihood of warping, without increasing their weight. They can be renewed at negligible cost, and like the rest of the movable parts of the machine are easily detachable for servicing. These valves rest on knife edges. Although this arrangement might make it easier for gas to leak back past the valves, it was found that when the valve rested on a narrow ledge condensation of water soon made the valve stick a little with consequent increase in the pressure required to lift it.

The absorber as a whole slides on two runners fixed below

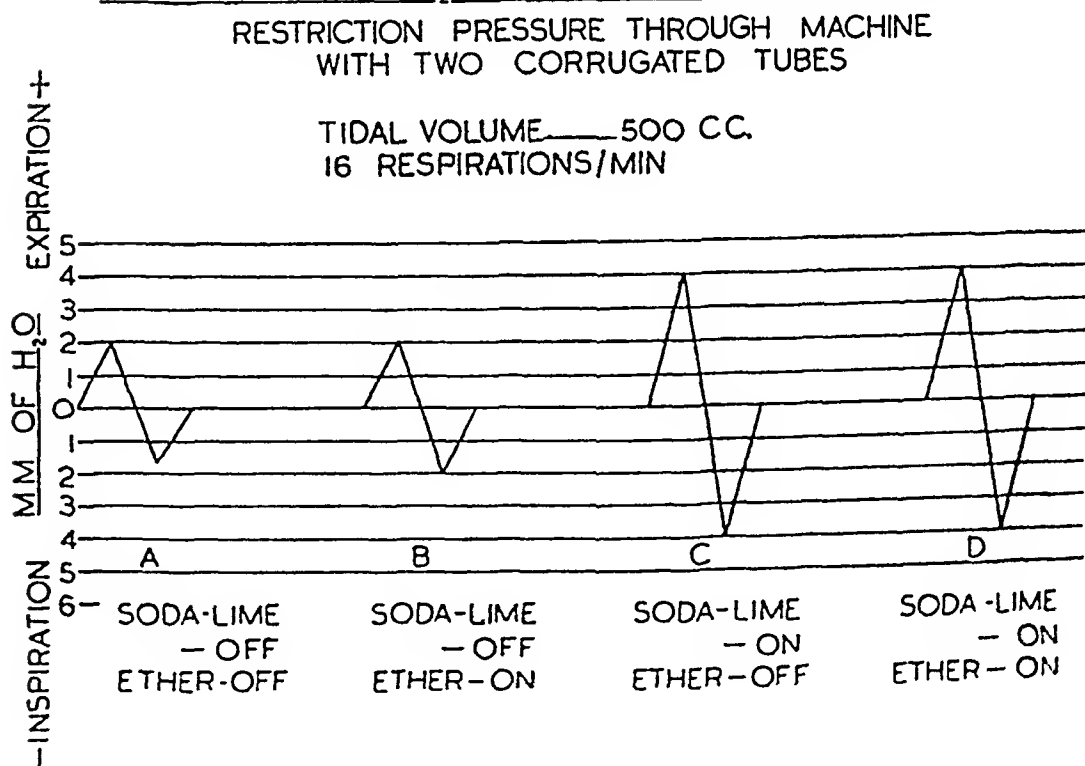


FIG 7
Restriction pressures

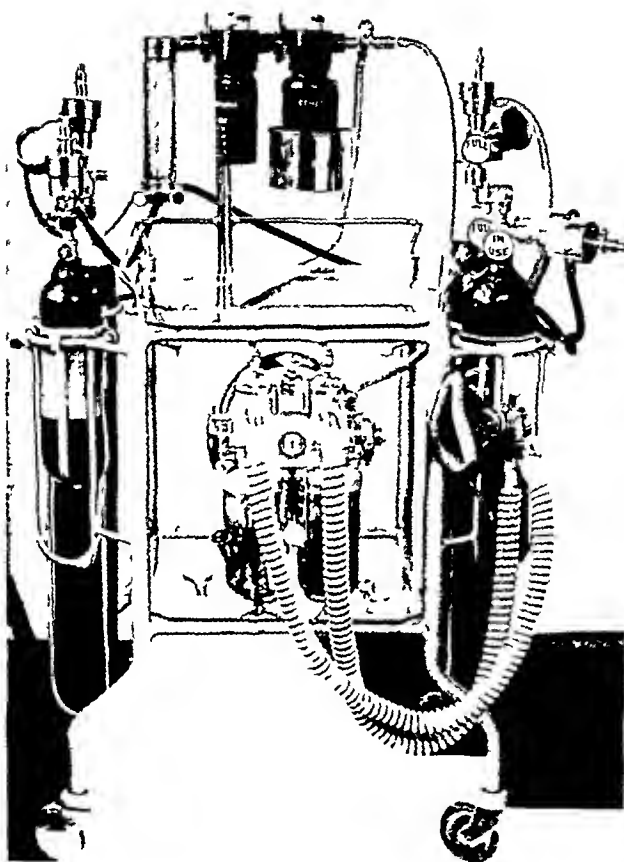


FIG 8
View of absorber *in situ* on standard Boyle machine

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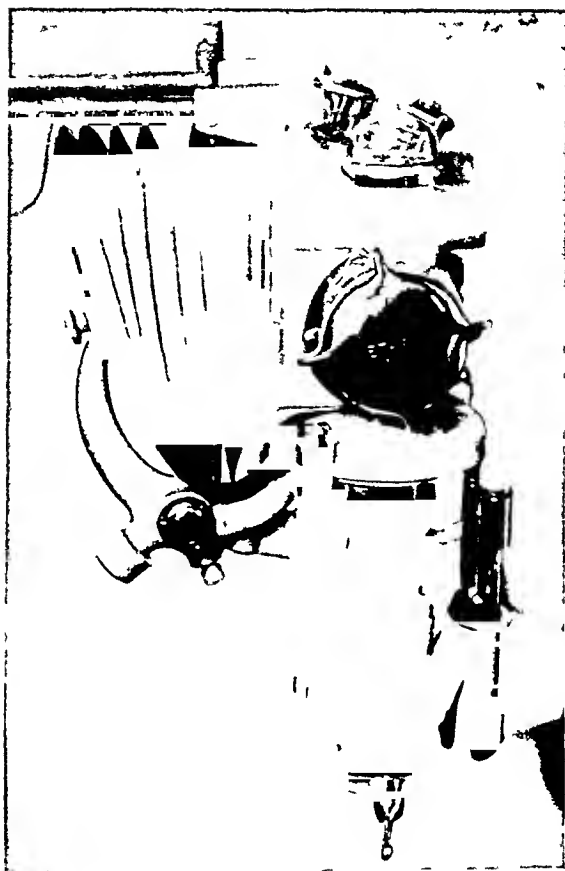


FIG 9
Side view of absorber

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the top shelf of the standard table supplied with the Boyle apparatus (Fig 8) This arrangement necessarily takes up a certain amount of the available space normally provided by the lower shelf The mounting of the rails on which the absorber slides is by four thumb screws, and though in the ordinary course of events it will never be necessary, the whole absorber and its mounting can be removed very quickly When not in use the absorber is pushed back so that it lies out of the way under the shelf of the table The gas entry nipple is connected by means of rubber tubing to the flow meter and bottles outfit of the Boyle The only rubber parts are the reservoir bag, the corrugated tubing and face piece, and the only taper joints are those at each end of the breathing tubes The corrugated breathing tubes connecting the machine to the patient, the "Y" junction with the face piece, and the face piece itself, are all of conventional design, though their failings are fully appreciated Active research in these matters is in progress

CLINICAL USE

The absorber has had an extended trial for a large variety of surgical procedures, using cyclopropane, ether or trilene as the main agents With the ether and soda-lime controls at the "off" position, the quantity of air in the machine is small, so that when starting anæsthesia the anæsthetic gases produce their effect rather more quickly than with most other absorbers The knob fitted to the end of the expiratory bag lever moves with the slightest respiratory effort, and is occasionally seen to move synchronously with the heart beat when the patient is in apnoea With the simple bag fitted on current E M S absorbers, slight movements cannot always be seen Here, every movement is transmitted to the lever, and is easily visible The slings between which this lever moves have graduated marks on them, so that the excursions of the bag at one period in the anæsthesia can be compared with that at another period Very light finger pressure on the knob is sufficient to inflate the average patient's chest, and artificial respiration and controlled respiration are easily performed The ether vaporiser gives a very gradual increase in ether concentration from nothing up to a maximum of

about 38 per cent (laboratory figure) The clinical trial confirmed the laboratory findings with regard to ether vapour concentrations, in that the patient tended to stay in a level anæsthesia, varying in depth, for each position of the ether control, even though the control was left untouched for some time This phenomenon is due to loss of ether through the rubber bag, and through the operation area and skin of the patient The restriction to breathing was found to be 2 mm of water with both soda-lime and ether off, and 4 mm of water with both soda-lime and ether fully on (Fig 7)

TEMPERATURE

Although the canister became quite hot to the hand, the temperature of the gases in the corrugated tubing next to the patient never rose above room temperature No provision is made in this machine for the drainage of condensed water vapour since any that does accumulate is easily removed by dismantling the bag or the outer soda-lime cover By avoiding drainage cocks (several of which would be necessary if the drainage is to be complete), more sources of leakage are eliminated The presence of a little water in the machine does not interfere with its working

To indicate the length of time that the soda-lime has been in use a small indicator has been fitted on to the soda-lime control knob *This time indicator can only be turned in one direction and should be moved by the anæsthetist at the end of each administration* This time indication, of course, is only of help when used in conjunction with the clinical signs of soda-lime exhaustion These clinical evidences should never be ignored, and form the only reliable guide as to when a change of soda-lime is desirable In any case, it is my own practice to rest a canister of soda-lime after each one-and-a-half to two hours of use

An expiratory valve, which can be completely shut or opened so as to lift on very light pressure, is placed on the front of the machine A valve in this position is convenient, since when the patient's head is in the operation field the bag can be emptied without fiddling with a valve under the towels Symmetrical with this is an inspiratory valve through

which air can be inspired. Two gas entry nipples are mounted one on each side of the machine. One is for the basal oxygen, and the other, with a tap, for the introduction of air.

Several of my colleagues have given a clinical test to this absorber and for their helpful suggestions I am most grateful. They have confirmed my opinion that only as a result of collaboration between the manufacturer and the user can a real advance in the design of anæsthetic apparatus be made.

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EXPERIMENTAL PART

The blood-pressure was taken in 125 soldier patients all of whom were E N T cases admitted for operation. As pre medication they were given chloralhydrate XXX grs (ad $\frac{1}{2}$ oz water) twice, the first dose being given in the evening before the operation, the second dose in the morning about 4 hours before the operation, leaving an interval of at least 8 hours between the two doses. Besides chloralhydrate per os they were given an injection of 1/100 or 3/200 gr (in the later stage of the investigation) of atropine. Readings of the blood-pressure were taken at least twice the first time soon after arrival in hospital, that is to say before any medication, the second time 3 hours after the second dose of chloralhydrate. A proportion of the cases was subjected to four blood-pressure readings the first two being performed as mentioned above, the third 1 hour after the atropine injection and the fourth on the day after the operation.

Each blood-pressure reading consisted itself of three measurements by stethoscope according to American usage,¹³ the first measurement being the point where the pulse sound reappears (systolic blood-pressure), the second one the point where the sound changes from a loud one to a weaker one and the third one the point where the sound disappears entirely. The judgment on rise or fall of the blood-pressure, however, has been based on the systolic blood-pressure only as experience has shown that this reading is the most reliable of the three, that is to say, the one which is almost free from subjective factors.

The main object of investigation was the comparison between blood-pressure reading 1 (before chloral) and blood-pressure reading 2 (after chloral). The distribution of the results is shown in Table I.

TABLE I
THE EFFECT OF CHLORAL ON THE BLOOD-PRESSURE
(OUR RESULTS)

		FALL										UNCHANGED					RISE				
Mm Hg		5	10	15	20	25	30	35	40	45	50		5	10	15	20	25				
Number of patients		17	17	22	21	10	11	5	-	3	2	4	4	3	2	0	2				
Percentage of series		13.6	13.6	17.6	16.2	12.5	13.7	6.2	2.5	3.7	2.5	5.0	15.0	17.7	2.5	0.0	2.5				

It is interesting to compare our results with those obtained by Alstead (1936) who investigated 55 cases (33 of whom had heart disorders

TABLE II
THE EFFECT OF CHLORAL ON THE BLOOD-PRESSURE
(ALSTEAD'S RESULTS)

	FALL									UNCHANGED	RISE			
Mm Hg	5	10	15	20	25	30	35	40	—		5	10	15	30
Number of patients	14	5	2	1	2	1	2	1	4		4	6	2	1
Percentage of series	25.9	9.1	3.6	1.8	3.6	1.8	3.6	1.8	25.9		7.3	1.1	3.6	1.8

If we consider our series as a whole, chloral produces an average *fall* of the blood-pressure of 15.4 mm Hg (-4.0 mm Hg, with Alstead). This average figure, however, is a bit misleading, as the group distribution shows a bigger effect in the direction of a fall of the blood-pressure. In 54 cases e.g. the fall amounts to 20 mm Hg or more. There is always a small percentage of cases (8.8 in our series, 23.7 in Alstead's) which respond to chloral with a rise of the blood-pressure, the cause of this individual reaction being unknown.

Our blood-pressure readings after the atropine injection led us to think that atropine counteracts the effect of the chloral to a certain degree by raising the blood-pressure again. In 45 cases in which the blood-pressure had been taken after atropine there was an average *rise* of the blood-pressure of 5.7 mm Hg. The distribution of the cases, however, shows that 26 responded with a rise and 12 with a fall while 7 remained unchanged. If we take the 26 plus cases alone, the average rise amounted to 14.8 mm Hg. In the later stages of the investigation (30 cases) we increased the amount of atropine to 3/200 gr, but the average rise of the blood-pressure was not greater than after 1/100 gr of atropine. A control experiment was made with 8 soldiers outside our series who were given 3/200 gr of atropine without any chloral. Only 4 of these cases showed a rise of the blood-pressure after 30 minutes. According to pharmacological experience atropine causes a slight rise of the blood-pressure.⁵

Blood-pressure readings on the day after operation were taken in 38 cases. In the majority (22 cases) the blood-pressure did not return to the level before the operation. It did return in 7 cases and went even higher in 9 cases.

The question can be raised whether the decrease in the blood-pressure is really due to the drug or to a night's rest or to other oscillations of the blood-pressure which usually occur even under normal circumstances, e.g. after mental stress. (An interesting experiment has recently been made in which civil defence workers were conditioned to air raid noises by producing them on records. Their blood-pressure rose by 15 mm Hg in the average.)¹⁴ Five soldiers outside our series in whom a control reading of the blood-pressure was taken after a night's rest in hospital showed the following figures: -5, -10, +5, +0, -5, this indicates an average fall of 3 mm Hg. It is, therefore, obvious that the effect of chloral exceeds the usual oscillations of the blood-pressure.

A further question was whether the decrease in the blood-pressure is accompanied by a fall in the pulse rate. Sixteen cases in whom the pulse rate was noted two hours after the second dose of chloral showed an average fall of the pulse rate of 6 beats. It could be questioned, finally, whether or not the slight increase in the blood-pressure produced by atropine was due to the fading out of the effect of the chloral. Some control experiments, however, showed that the effect of chloral on the blood-pressure is still traceable after many hours (6 to 8).

CLINICAL OBSERVATIONS

Our clinical observations were based on the study of a series of 162 soldiers undergoing general anaesthesia for ear, nose and throat operations controlled by a series of 132 soldiers undergoing operations of the same type by the same team in the previous four months who were given $\frac{1}{4}$ gr of morphia and 1/100 gr of atropine as premedication. The bulk of the operations were either submucous resections of the septum nasi or removals of tonsils by dissection. Chloralhydrate causes the patients to fall asleep in about half an hour. The sleep is sound but the patients are easily roused and usually arrive awake in the anaesthetic room being then well

orientated and not at all anxious. The patients are more sensible and co-operative than after omnopon and scopolamine.

During the induction of anæsthesia (NO_2 and O_2 or open Ethylchloride) no respiratory depression was noticed so that induction was quick. Maintenance of anæsthesia was by intratracheal N_2O , O_2 and ether. Less ether was required than with morphia and atropine premedication. The pupils were larger at every stage of anæsthesia. The cough reflex returned promptly after operation but there was a tendency to restlessness which was controlled in the later cases by morphine gr $\frac{1}{6}$ given immediately after operation.

As to postoperative complications there occurred a few cases (3 to 5 per cent) of bronchitis, local sepsis and secondary hæmorrhage in both series, their number was slightly less in the chloral series. There were no cardiovascular complications at all and none of the other complications was serious.

CONCLUSIONS

Chloralhydrate premedication has the advantage of allaying anxiety without depressing respiration or delaying the return of the cough reflex, furthermore, it is reliable in its clinical effects. It reduces the amount of ether required, is cheap and easily obtainable.

As disadvantages must be mentioned its nasty taste (which can be mitigated by dilution and flavouring with synthetic lemon) and the occasional postoperative restlessness which can be controlled by a small injection of morphine (gr $\frac{1}{6}$) immediately after the operation. This is the more advisable as chloral is not an analgesic.

Our experience with chloralhydrate leads us to believe that it deserves to be used more widely as a premedication.

SUMMARY

In about 160 cases chloralhydrate with atropine proved to be a safe and satisfactory preoperative medication. Its main advantage is that it reduces fear without depressing the respiration or cough reflex. The effect of chloralhydrate on the

blood-pressure has been more closely studied and found to be far short of the danger line

We wish to express our thanks to Dr F Pygott, Acting Medical Superintendent, for the helpful interest he has shown in this work

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A LAYMAN'S ACCOUNT OF "GOING UNDER"

By D I. Evans

Contributed by DR C F HADFIELD

MOST people who have had an operation would, I think, regard going under the anæsthetic as the most interesting part of the whole business. It is certainly more pleasant than the process known as "coming round," for that journey back from oblivion is a dark and gloomy one! With the first sensation of the body's pain, there surges up from some lower region of darkness a desire to be dropped back into the merciful nothingness of a few moments ago. Across the murky dawn of consciousness prayers drift like phantom clouds. Curses shoot upwards and break the grey surface of the awakening mind, swirling there like ferocious fish. Slowly, through the mists, realisation breaks. He has been somewhere. Truer, he reflects bitterly, to say that he has been to the place called "nowhere," to oblivion, to Nirvana, the heaven of the Orientals. So these damned eastern devils practise their tortures even in the sacred courts of their gods! And so his groping mind stumbles on to collapse at length into a baffled stupor. But I am being led away from my theme.

I know nothing of "how the thing actually works." I cannot give an exact description of what happens to the body, nor what laws govern the behaviour of the mind as the world of our normal senses recedes farther and farther away. Previous to the actual experience I had fancifully compared it to what happens when the incoming tide invades the rocky shore. One by one the myriad little tunnels and crevices are filled. Farther and farther, deeper and deeper, the relentless flood penetrates, until it breaks at length into the last remaining stronghold of the mind, and then—oblivion. The actual thing was not at all like that. There was a swift and supremely dramatic climax that one does not associate with an incom-

ing tide But in another sense the figure is appropriate It does suggest something that went on for a fairly long time When I was wheeled away to the theatre by a pair of white-robed attendants whom some grim humorist had christened "the body snatchers," a subtle influence was already at work knocking at the doors of my will I had been given the usual preliminary dose of some drug It was claimed for this that it had the power to send you to sleep However, I was not asleep, but yet not fully aware Lying on my back underneath what seemed a mountain of blankets, I reflected that now there was no escape The die was cast The course must be run

My feelings in the little anteroom before they gave me the stuff are, I suppose, common to most Once or twice a little wave of panic rippled across my mind What if they started before I was completely under? What if I came round before they had finished? But by pinning my faith to the acknowledged skill of modern doctors, by remembering that countless others had come through without mishap, and by reminding myself that it was all for my own good, these fears were more or less successfully banished The prevailing mood was one of idle curiosity—idle because the working of the drug prevented me taking a really intelligent interest in my surroundings Lying on one's back gives only a very restricted range for the eye, but by turning my head to one side I saw that I had been brought close to a table whereon were laid the instruments of darkness It was a cheerful enough sight—bottles of bright green and white, and among these the bright little servants of the surgeon's art, but here and there the rather sinister twist of brown tubing like the coils of a snake Then a rubber strap was placed around my head or neck (or both) and a towering figure in white loomed over me I heard him say, "Have you had this before?" I replied, "No sir" I remember wondering what he would have done or said if I had replied "Yes" The question seemed to me to be pointless Perhaps he wanted to know whether I was "out" already with fright

Then the rubber cap was fixed over my nose and mouth Being too sleepy I did not hear the instructions to "close your eyes" and to "breathe naturally" However, to show them

that I was sensible and unafraid, I co-operated by doing these things of my own accord. A few seconds passed during which I seemed to concentrate on a certain buzzing and the gas pouring in. I remember congratulating myself on being still able to hear some words that were spoken. What they actually were I could not say. The longer I tried to disentangle their meaning the more confused they became. They ran into one another like some fantastic anagram of sound that got more and more beyond my power to solve. Then I lost interest in it. To remind them that my control had not yet completely faded away, and that I was not yet ready for the slab, I opened my eyes. A blurred, formless, white shape seemed to draw away from me suddenly. "Just in time," I thought. I was convinced that my timely action had prevented what would have been a very unhappy situation.

I find it difficult to convey to you my next reaction. It seemed as though my mind was being drawn out of my body and entering into that kind of existence it would have were it not housed in the flesh. It was as if the cables holding me to the earth were being untied, one by one, and, when the last was cut away, I rose, like a balloon set free, into the rarer levels of the air. I suppose that the nearest we ever get to this state in ordinary life is when we dream. But there is a difference. In dreams we recognise the sights, shapes, and sounds of our normal life, but in my experience I could not distinguish any of these things. Imagine a huge disc covered with concentric blue and white circles, like a huge firing target. Then think of this as revolving at great speed and retreating and advancing with uncanny regularity. There was nothing else. The whole field of the mind's vision was filled with those circles that sped away into the distance and dwindled to a mere point. Then, just when that remote speck seemed to vanish altogether, it would grow again and resolve itself into the same pattern, but this time racing towards me with incredible speed. Backwards, forwards, backwards, forwards. I remember marvelling at the smooth, effortless, regularity of it all. But I not only marvelled. I actually *thought*

I remember my mind running along these lines. "Yes. This must be what they mean when they talk of 'another

plane of existence'—the plane of spirits who live by other laws than ours I wonder what it would be like to live on one of these planes " A poetic phrase suggested itself to me and I found myself summing up the new situation in the words "unknown modes of being " Then came the strangest idea of all These retreating and advancing circles suggested themselves to me as the final explanation of life The eternal problems of both God and man were all resolved into this fantastically simple equation Life, the whole of life, was nothing more than a process of becoming, growing, fading, dying (did not the behaviour of the circles prove it?)—a process that must go on and on to infinity with a perpetual motion conceived only in moments like these There was about the whole thing a strange impersonal beauty—the perfection of a machine that can never falter or cease to function I think that my mind registered a faint protest when I found life reduced in its last analysis to this infallible clockwork What about the courage of human hearts, and the love of God ? But no answer was forthcoming from those silent whirling circles

Suddenly the circles began to revolve at a greater speed, and retreated and advanced with an ever-increasing momentum Although the rhythm was accelerating it never strayed for an instant from its immaculate regularity, and the circles maintained their perfect symmetry I thought of them now as a spring that was being wound and unwound, each time tighter than the last I could see the inevitable end of this madness, and somewhere in my soul there must have been a great terror Mercifully I was beyond its reach and viewed the approaching catastrophe with a calm detachment

Then the very limit of speed and strain was reached, but at the very instant of the bursting of the spring I slid into a total eclipse

I seem to recollect that for a fleeting second I imagined that spring to be the mainspring of the universe Had I been given a vision of the end of all things, or, perhaps, of my own end ? Intriguing questions, but who shall answer them ?

The preceding graphic account was handed to me by a Lady House Surgeon at the E M S Hospital at which I

work with the explanation that it had been written by a patient for his own amusement and given to her to read in case she should be interested. From internal evidence I guessed he belonged to the R A F as it seemed likely that the advancing and receding circles of his vision were suggested by our well-known aeroplane markings.

I had, I found, anæsthetised him some days before for the performance of a simple operation, and the fact that I had no recollection of his case shows that the induction must have been quite smooth and uneventful. From my notes I see that he had nitrous oxide and oxygen with "Trilene," passing later to ether to obtain more complete relaxation. I have little doubt, however, that his mental experiences must have occurred during the former period as he would have been too deeply anæsthetised to remember anything before any ether was given.

Later I had a long talk with Mr. Evans and found that he was greatly interested by my suggestion that his essay should be printed. I also found that I was correct in my surmise that he belonged to the R A F, his present rank being "A C 1" in that Service. He also informed me that he had never before written for publication and that, apart from his ordinary course as a student at Cardiff University and his civilian occupation as an English master in a Welsh secondary school, he had never done any literary work at all.

I was particularly interested in his description of how at a certain stage he reached a point at which the whole meaning of life was made not only plain, but simple and uncomplicated. This recalled to my mind a patient of my own whose experiences I have sometimes spoken of at anæsthetic meetings but never recorded in writing. Several years ago, on some two or three quite separate occasions, I was asked to administer nitrous oxide to a middle-aged gentleman for simple dental extractions in the usual manner. On each occasion as consciousness returned he waved his hand, almost jumped from the dental chair, and excitedly exclaimed "It's just like this" and then no more. He would later explain that while he was unconscious the whole "Riddle of the Universe" had been solved and made abundantly clear. The mystery of life and death, of time and

eternity, of good and evil, of the future and the past, had been not only cleared away but interpreted in a manner as simple as it was entirely convincing. His first conscious desire was to announce it while it was still clear in his mind but before he could get out more than two or three words it vanished altogether from his recollection. If I remember correctly he told me that he went through exactly the same experience whenever he took gas (which he had had a good many times) so that his vision could not be ascribed to any peculiarity in my administrations!

This immediate fading of the dream experienced under short nitrous oxide anæsthesia is of course so common as to be almost universal. The importance of my case rests on the particular nature of the dream and the interest there would be if it could be retained and recorded—although it might, and probably would, turn out to be pure rubbish.

The consideration of these cases calls to my mind another story which although cognate is interesting as being in some ways their converse. In my Cambridge days and long before I had any interest in anæsthesia, I was well acquainted with an aged and retired minister of religion who was in fact the father of the headmaster of my old school. This reverend gentleman told me that on one occasion he had been given gas for a dental extraction. Details I have forgotten, if I ever knew them, but it is unlikely that it was a prolonged nasal gas as I do not think this method was practised in those days. On recovering consciousness he immediately asked how long he had been under the anæsthetic, and when told that it had been a matter of two or three minutes, he refused to believe it and was only convinced by reference to his own watch and other obvious evidences. The reason for this curious scepticism was that during these short moments he had, in his dream, lived through a period of two complete years. And in this case the dream, far from being forgotten, was still present in his mind in all its details. He had, in fact, later written out a long account of it which at the time I knew him he still possessed. I myself never saw it, for as I have said I was at that time in no way particularly interested in the subject. Another curious thing about this dream was that it had no connection with the events, scenes, and persons of his waking

life He had dreamed that he was a village schoolmaster and he was able to describe the life and characteristics of the villagers and the course of events during the whole two years of his vision—years well marked, as he said, by the coming and return of two Springs, two Summers, two Autumns, and two Winters

In most dreams, as Mr Evans points out, "we recognise the sights, shapes, and sounds of our normal life," and he might have added some, at any rate, of the persons, but in his experience he could distinguish none of these things The same was true of my aged friend's dream existence The village in which he lived and the people he associated with there were fresh creations of his mind and altogether unconnected with any he had ever visited or met in actual life

What does it all mean? Possibly something, much more probably nothing Perhaps the psychologists can tell us If they can I doubt very much if I shall believe them !

THE RECTAL ADMINISTRATION OF PENTOTHAL SODIUM

BY

A R HUNTER, M D , D A

SOME eighteen months ago the author published in this Journal an article describing the effects of the short acting barbiturates administered rectally. From the investigations then carried out it was concluded that Pentothal Sodium was too erratic in its action to be successfully employed as a rectal basal narcotic. Since the publication of the article in question the author's attention has been drawn to the work of Weinstein and Adams in whose hands Pentothal proved quite satisfactory for rectal injection. Lest the conclusions previously enunciated had been vitiated by the use of stale solutions it was thought desirable to repeat this part of the experiment with doses made up immediately before use. Each patient received 15 mgm of Pentothal per pound of body weight, this is rather less than the amount recommended by Weinstein and Adams but experience with similar drugs has convinced the author that British patients respond well to doses smaller than those customarily given in America. The subjects of this experiment were adults, mostly females, who required tonsillectomy. In addition to the Pentothal each patient received 1/60th of a grain of atropine by hypodermic injection half an hour before operation, no preliminary opiate was administered.

The results were satisfactory though not perhaps quite so good as those with the sulphur free barbiturates. Of 21 patients 5 were asleep at the time of operation, i e one hour after the administration of the Pentothal. The remaining 16 were deeply under the influence of the drug and exhibited lack of emotional control, slurring of the speech and nystagmus. In short they appeared to be very "drunk". Two of the 21 patients were unduly pale and showed a certain

amount of diminution of the volume and force of the radial pulse. The degree of hypnosis produced was, however, remarkably uniform, having regard to the variability of action of Pentothal administered intravenously. Postoperative restlessness was encountered on three occasions but was never so violent as that sometimes met with after the use of sulphur-free barbiturates.

In general the rectal administration of Pentothal Sodium in a dosage of 15 mgm per pound of body weight is a safe and satisfactory method of obtaining fairly deep basal narcosis.

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THE ASSOCIATION OF ANÆSTHETISTS, GREAT BRITAIN AND IRELAND

THE Annual General Meeting of the Association of Anæsthetists of Great Britain and Ireland was held at the premises of the Royal Society of Medicine, 1 Wimpole Street, W 1, at 2 p m on Wednesday, October 28th. The following Officers and Council were elected for the ensuing year

President Lt-Col Ashley Daly, D A, R A M C

Vice-President Dr C F Hadfield, M B E

Hon Treasurer Dr Z Mennell

Hon Secretary Dr A D Marston

Council (12 members)

Provincial

Major H W Featherstone,
R A M C

Air Commodore R R Mackintosh,
R A F, V R

Major C E Sykes, R A M C

Dr R J Minnitt

Dr J Beckett

London Area

Dr J Blomfield, O B E

Dr A W Matthew

Dr C Langton Hewer

Dr I W Magill

Dr R Blair Gould

Dr J K Haslar

Major V Hall, R A M C

Six ordinary members were elected to the Association and Sir Francis Shipway, K C V O, M D was elected an honorary member

REFLEX CARDIAC INHIBITION UNDER GENERAL ANÆSTHESIA

BY

K E MADAN, M D , D A , D O M S , F I C A

*Lecturer in Anæsthesia, King Edward Medical
College, Lahore, India*

DURING an operation under general anæsthesia there may arise various conditions which can cause shock, and reflex cardiac inhibition. One of the causes which I have sometimes observed in my long experience and which has not so far been pointed out, is the therapeutic use of ether by the surgeon, by pouring it into the abdominal cavity in tuberculous diseases of the intestines, etc. Some surgeons of the old school seem to believe that the pouring of ether inside the abdominal cavity before its closure is beneficial to the tuberculous patient, as it is antiseptic, stimulant, and a solvent of the fatty capsule of Tubercle Bacilli. This is not really so, because instead of doing any good the ether inside the abdominal cavity might, as pointed out below, cause severe shock and even prove fatal. With the patient supine and the table in Trendelenburg position, the ether when poured into the peritoneal cavity gravitates upward to the diaphragm, due to the peritoneal watersheds, and thus shock at once takes place from sudden hyper-excitability of the vagus and of the solar and splanchnic plexuses.

Sometimes even half an ounce or more of ether is poured and left in the serous sac before the last one or two peritoneal stitches are applied to close it, and to ensure the ether remaining well inside the cavity the sensitive peritoneal edges are first pulled up with forceps and kept taut for suturing, which in itself causes some shock.

If the peritoneum is thickened from chronic fibrinous deposits, the shock is sometimes lessened

Ether is very cold, irritating, and lowers the local resistance of the tissues to infection, and in the most sensitive and rapidly absorbing serous sac it sometimes sets up a dangerous reflex sufficient to cause reflex cardiac inhibition. This is particularly the case on a very hot summer day in the tropics when the body temperature remains sometimes even a little above normal, with no cooling system in the operation theatre, and in weak, exhausted patients with fever, the sudden intense cooling of the serous sac by pouring ether into it and thereby the sudden lowering of the temperature of the gut and the sac, has been definitely seen by me sometimes to suddenly produce grave shock, marked change in respiration, reflex muscular rigidity, and even death. The muscular rigidity is due to irritation of the lower intercostal nerves, the ramifications of which are present in the peritoneum. Death is due to fibrillation and reflex cardiac inhibition. This may happen in spite of atropine given as premedication to lessen vagal irritability. The ordinary means of resuscitation, injections, etc., are then of no avail.

As Crile rightly says, shock is felt by the brain even though the patient is under general anæsthesia, and particularly at the end of an operation when the peritoneum is nearly sutured, the anæsthesia is reduced, and so the patient is at this stage in a state of comparatively light anæsthesia. The tendency to reflex cardiac inhibition by over sensibility of the vagus is always high under light anæsthesia, it is higher with chloroform than ether, or nitrous oxide and oxygen.

The pouring of ether into the abdomen is, therefore, at times, the last straw that breaks the camel's back in a weak patient who has been exhausted by exploration and manipulation during a prolonged abdominal operation, with the added depression of an anæsthetic.

This grave complication from ether occurs late in the operation, so also it is well known that convulsions due to ether occur late in a long operation, when the patient is exhausted and has absorbed a big dose.

Just as irrigation and the injection of antiseptics in the pleural cavity have been given up due to the shock it

produces, so also the instillation of ether in the peritoneal cavity should be condemned, as it may prove dangerous as stated above. If at all ether is required to be poured into the peritoneal cavity, the amount should be very little, and the table should be in Fowler's position and never in Trendelenburg's.

SERVICE ANÆSTHETISTS

THE following list completes the names of those serving with the R A M C (the first list was in the Journal for July 1942)

We also append the names of Anæsthetists in the R A F

Keates, Major G H W
Keating, Captain J
Kirk, Major R S

Lawrence, Major R C
Laycock, Captain J D
Leon, Lieut K W
Lerman, Major L N
Lewis, Major W H
Linacre, Captain J L
Longthorne, Lieut S W

Maidlow, Lieut W M
Mahon, Lieut R W
Mark, Lieut S
Mellon, Captain E R R
Moffat, Major J O
Milner, Major C N
Montgomerie, Major J
Moore, Major R H
Morton, Major J A
Mountford, Major L O
Murphy, Major T T P
Murray, Major J L
Murray, Captain W H
McCartney, Captain (Mrs) E M
MacLaren, Lieut H C
McConnell, Major W S
McCullough, Captain D E P
McCoy, Major D P

Neill Major H G
Neville-Jones, Major R
Nicholson, Major J

O'Hara Proud, Major F R P
O'Neill, Major M B
Ord, Major J W E
Overton, Major R E

Palmer, Major E A E
Patrick, Major H C
Perreclès, Captain J F
Porteus, Major H B
Pleasance, Major R E
Porter, Captain N C

Quayle, Major G
Quigley, Major T

Rawlings, Major N W
Rea, Major S B
Redgate, Major J W
Rink, Major E H
Roberts, Captain (Miss) H
Rochford, Captain J D
Rogerson, Captain H L
Ross, Major K M
Rowbotham, Major E S
Rowatt, Major J

Saleh, Captain A H
Savage, Major J M
Schalt, Captain J
Shaw, Captain R
Shemelt, Captain P
Shepphard, Major S G
Sington, Major H S
Shaceh, Captain M R E

Stewart, Major C
Swabey, Captain E E
Sykes, Major C E
Sykes, Major W S

Talbot, Major N G
Taylor, Captain J H
Tennent, Major R A
Thompson, Major O S
Thornton, Major H L
Thornton, Major K B
Toland, Captain C P K
Torrance, Captain A S
Treevich, Major J A
Turner, Captain F L

Walter, Major W J
West, Major J H
Wevill, Major L B
Wilson, Major E A
Williams, Lieut A M
Willis, Lieut J H
Wilson, Captain J S H
Winterbottom, Captain W C
Wood-Smith, Major F G
Wright, Major H D K
Wyater, Major (Miss) T M
Wyse, Major H D

*Anæsthetists in the R A F
working as Anæsthetists in R A F Hospitals*

Anson, S/Ldr B J E
Attwood, W/Cdr J H
Brand, F/Lieut T M
Dinnick, F/O O P
Ebsworth, F/Lieut J D
Edwards, F/Lieut H V
Fraser, S/Ldr A C
Gray, S/Ldr G
Graham, F/Lieut John
Heyworth, F/Lieut P S A
Hindmarsh, F/Lieut J R
Hughes, F/O T H
Lucas, S/Ldr B G B

Osbourne, S/Ldr S E
Panton, F/O G F
Pickup, F/O J D
Pooler, S/Ldr H E
Rose, S/Ldr G M
Rickards, F/Lieut J F
Reid, F/Lieut C
Smith, S/Ldr W J A
Stoneham, F/O F J R
Skinner, F/O E G F
Soper, S/Ldr R L
Thomas, F/O K B
Wilson, F/O H Bruce

*Anæsthetists in the R A F who hold the D A
but are at present doing work other than Anæsthesia*

Crawford, F/Lieut J
Evans, S/Ldr W E F
Harvey, S/Ldr H F

Jenkins, S/Ldr C R
Pask, F/O E A

ABSTRACTS

"Effect of Desoxycorticosterone Acetate in Post-operative Shock" KOSTER and KAGMAN in *Archives of Surgery*, Vol 45, No 2, p 2724

FROM clinical, pathological and experimental data the authors believed that adrenocortical substances should have value in the prevention or the treatment of shock. It has been held also that failure of the adrenal glands precipitates a state of shock. The authors' observations reported in this article were all made on patients operated on under spinal anaesthesia. There were 200 patients and the value of any addition to the therapy ordinarily employed should be reflected, it is stated, in the mortality rate. If desoxycorticosterone acetate could do anything to prevent death, these patients, all suffering from grave lesions, would offer it a fine chance to demonstrate its usefulness. The authors came to the conclusion on analysis of their results, that there was no evidence that the therapy prevented or favourably influenced shock.

"Pre-operative and Post-operative Medication" M D LEIGH in *Canadian Medical Association Journal*, August, p 150

To obtain the greatest benefit from pre-operative medication the anaesthetist should consider (1) desired effects, (2) available drugs to produce these, (3) dosage, (4) time and method of administration. The desired effects are, firstly, a quiet and comfortable patient without apprehension of the operation or anaesthetic, and, secondly, reduction of toxicity from the latter. Medication increases the amount of oxygen which can be supplied with nitrous oxide and ethylene. It protects against excitement and convulsion from local anaesthetics. Two main groups of drugs bring about the desired effects. First are the opiates, morphine, codeine, dilaudid and others and evipan and pentothal. These, besides producing a state akin to sleep, have good analgesic properties. The

other group are purely hypnotics, nembutal, seconal, avertin, paraldehyde and others

As to time there is some latitude. When nitrous oxide or an intravenous barbiturate is the anæsthetic it is best to take advantage of the maximum analgesic property of the opiates. This is generally reached after one to one-and-a-half hours. Intravenously the opiates have maximum effect in twenty minutes. Chloralhydrate by the mouth and paraldehyde and avertin rectally, reach their peak hypnotic effect in about half an hour.

Two post-operative conditions call for a sedative, pain and restlessness. It must be remembered, however, that the pre-operative dose is probably still acting to some extent.

"Ether, the All-purpose Anæsthetic" D. G. REVELL Jun.,
Canadian Medical Association Journal, September
1942, p. 235

The author is mainly concerned with the importance of heat factors in ether anæsthesia. He describes original apparatus for delivering moist, warm, ether vapour. The thermal energy necessary for vaporisation of ether on a mask is borrowed from the inhaled and exhaled atmosphere passing through the ether-wetted covering of the mask. Most of this heat debt has to be made good by the mucosa of the upper respiratory tract, which in turn depletes the body heat. The normal function of the upper respiratory tract includes warming and moistening inhaled atmosphere so that the alveolar epithelium may carry on gaseous exchange under optimum temperature and humidity conditions. Therefore we should avoid routine or unnecessary use of pharyngeal or endotracheal airways and tubes during drop ether technique. To facilitate even administration of ether in the semi-open technique, Revell has devised an ether dripper which may be attached to the mask and adjusted to deliver ether at the desired rate. The generation of ether vapour at a short distance from the patient for any insufflation technique raises the problem of adequate and controllable heat to carry on the volatilisation. The author devised an apparatus which supplies ether vapour of any desired concentration almost

indefinitely The essential principle involved is the vaporisation of liquid ether right in water in a closed container which is automatically kept at a temperature slightly above the boiling point of ethyl ether

"Blood-pressure During Spinal Anæsthesia" HARRY KOSTER in *Archives of Surgery*, October 1942, p 597

The author reviews the literature of the subject and then relates his experience with persons who had received a spinal injection but had not yet been operated on The blood-pressure of these people was studied before and during spinal anæsthesia under three sets of conditions The conclusions at which Koster arrived were (1) there is approximately the same percentage drop in systolic and diastolic pressure during spinal anæsthesia in patients not subjected to operation

(2) The development of hypotension following the induction of spinal anæsthesia in patients with the extremities supported by elastic bandages, or in the extreme Trendelenburg position, is evidence against veno-dilatation as the cause of the fall in blood-pressure

(3) The decreased blood-pressure indicates a decrease in cardiac output This is a factor but probably not the only one responsible for the hypotension of spinal anæsthesia

"Control of Pain in War Surgery" *Bulletin of War Medicine*, December 1942, p 211

Holle says first choice for almost all patients in front-line surgery is scopolamine-eukodal-ephetonin given by intravenous injection Eukodal is a substitute for morphine, with formula $C_8H_7NO \cdot HCl$, and ephetonin is a blood-pressure raiser of the ephedrine type

The drugs are provided in two strengths

Scopol	0 005 and 0 001 grm
Eukodal	0 01 and 0 02 grm
Ephetonin	0 025 and 0 05 grm

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“ *Refrigeration Anæsthesia* ” L W CROSSMAN, F M ALLEN
and others in *Anæsthesia and Analgesia*, October
1942, p 241

The authors first discuss the effect of local asphyxia as produced by a tourniquet and show that at ordinary temperatures a limb can survive without necrosis 12 to 15 hours complete deprivation of blood. Local temperature enormously influences the effect of a tourniquet. Elevation of temperature accelerates gangrene in a bloodless limb. Contrarywise the influence of lowered temperatures is illustrated in the preservation of living tissue in an ice-box. Lives can be saved by using cracked ice, snow ice or ice water as the only means of anæsthesia for amputation in feeble subjects, e.g. those with gangrene who are old, underfed and discouraged. No drug is needed as an aid to anæsthesia but a strong sedative is given. The technique is described and highly successful results claimed. Patients apparently inoperable were successfully subjected to amputations under refrigeration anæsthesia and recovered after amputation. The anæsthesia lasts about one hour. The stump is surrounded by ice-bags for 2 or 3 days. The authors claim that they work with anæsthesia of protoplasm in contrast with the usual anæsthesia of nerves only.

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REVIEWS

"Fundamentals of Anæsthesia" An Outline, by The Subcommittee on Anæsthesia of National Research Council Published by American Medical Association Press, Chicago 216 pp

THIS book has been written primarily to serve as a basis for the instruction of Medical Officers in the Armed Forces of the U S A. in anæsthesia

In explaining this fact the authors state that they have emphasised the principles of safety governing the administration of depressant drugs and the care of patients suffering from circulatory or respiratory depression, and have attempted to dwell on principles at the expense of detail

This work contains a most comprehensive description of all types of anæsthetic agents and their modes of administration, and includes many excellent diagrams and illustrations, and a novel way of emphasising any special point by printing a phrase in large type at the foot of the page where it may readily catch the eye of the reader

One chapter of particular interest contains a concise account of the signs, symptoms and treatment of special poisons—including war gases

Transfusion of blood, plasma or serum, a treatment which was responsible for saving the lives of many war casualties in this country, has been very briefly mentioned This is unfortunate, but doubtless must be attributed to the fact that the authors have had little experience of this treatment during the present war

There is a full, clear description of local and regional anæsthesia and the recent increased popularity of this technique for civilian and war casualties makes this section with its excellent diagrams of unusual interest The subject of spinal anæsthesia has not received the same full attention, and one learns little of value from the brief note on this subject

This work is undoubtedly of great value as a book of

reference. In spite of the authors' statement to the contrary, it contains a wealth of detail, it is, however, not easy to read, as the arrangement of the contents is confusing and makes it difficult to sort out the important facts from the mass of less important details. It is feared that the student or inexperienced anaesthetist will gain less from the perusal of its pages than will the anaesthetist of some experience.

"Recent Advances in Anaesthesia and Analgesia" By
C. LANGTON HEWER Fourth edition Published by
Messrs J and A Churchill Ltd pp 341 Price 18s

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Though the arrangement of chapters is similar to that of previous editions, where a good deal of work has been done on any subject the chapter has been almost entirely rewritten. This is the case with "*Anaesthesia and Analgesia in Thoracic Surgery*," and *Oxygen Therapy*, which contain a clear, concise account of modern methods in use.

The reader will find references to all recent work done in Anaesthesia. Those who know the high standard of the author's previous work, will not be disappointed in this edition. It is one of the best books ever written on anaesthesia and analgesia, and should certainly be read by every anaesthetist.

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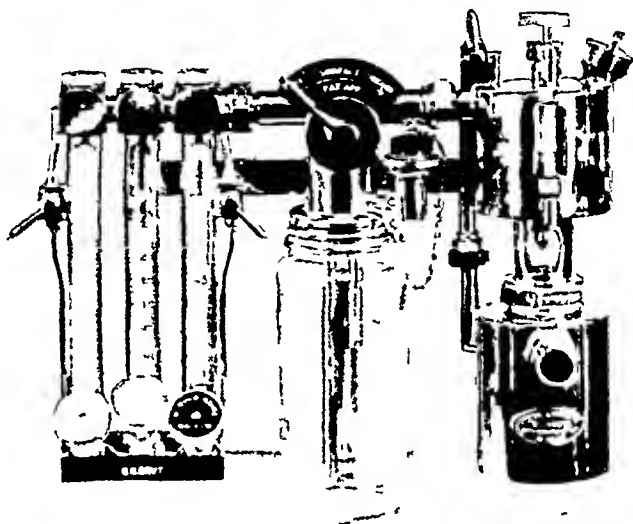
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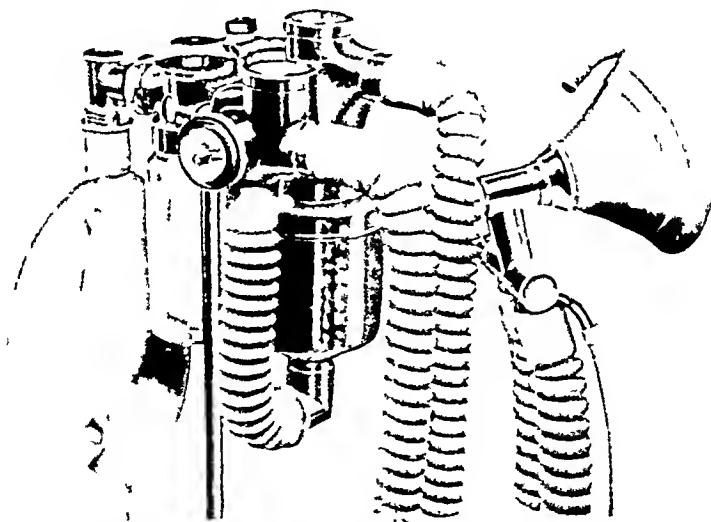
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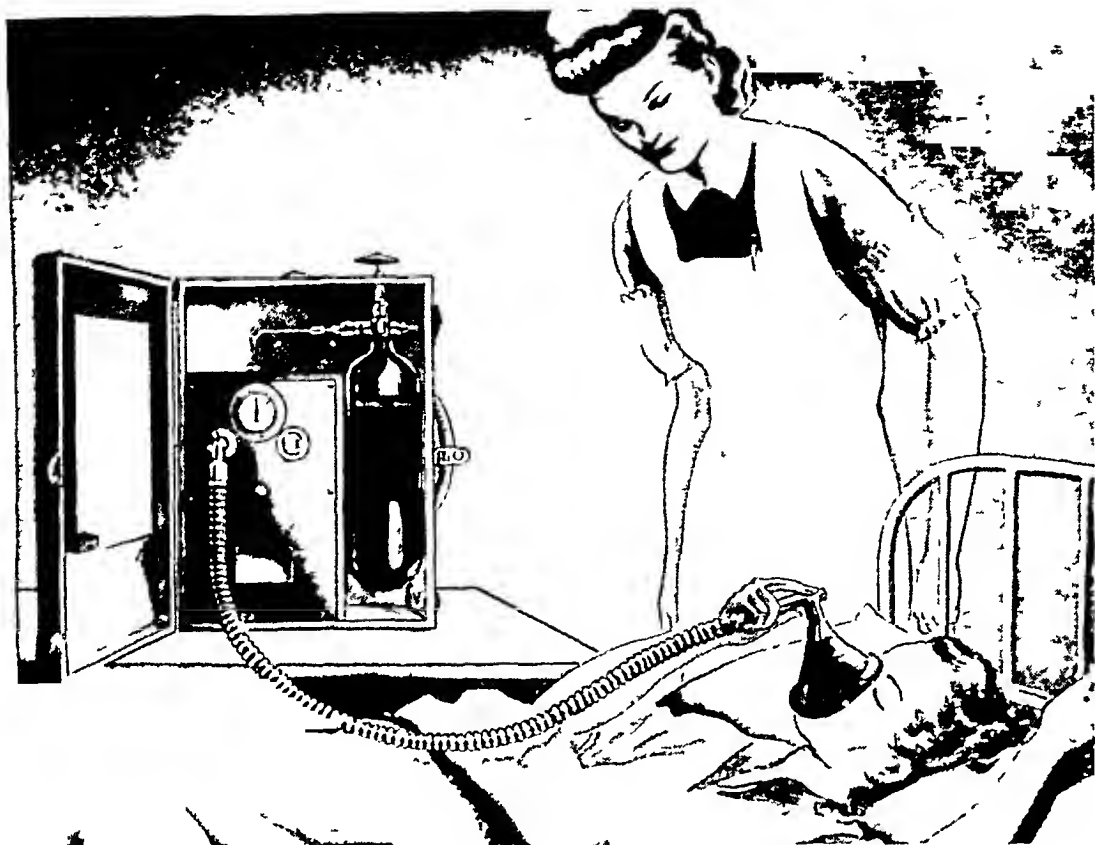


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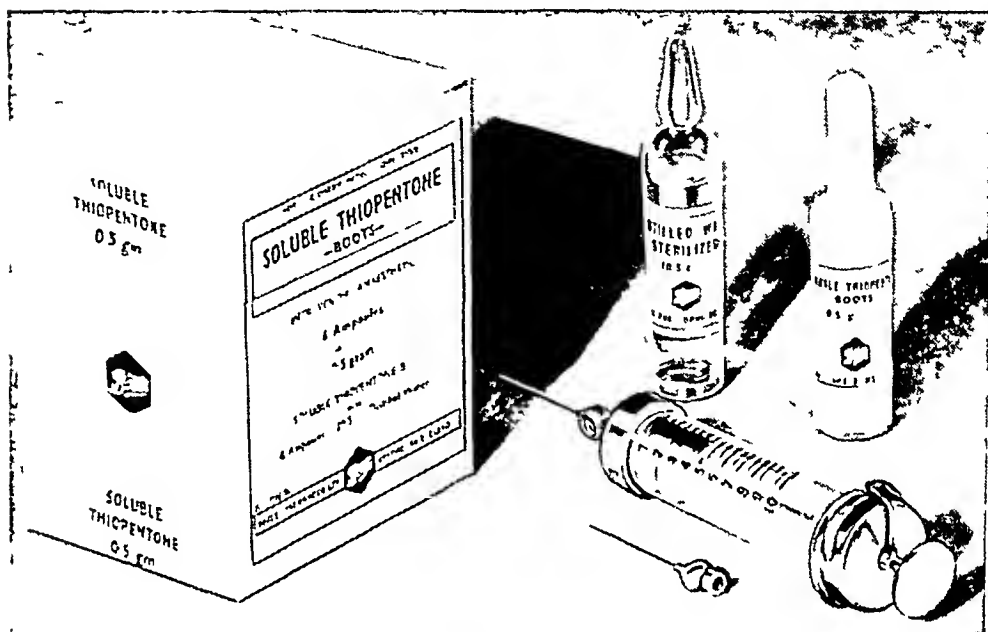
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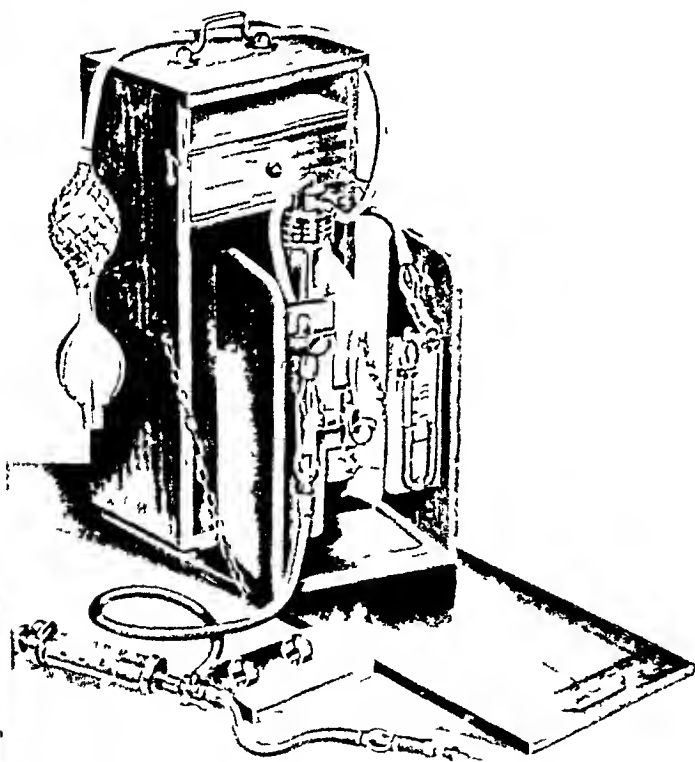
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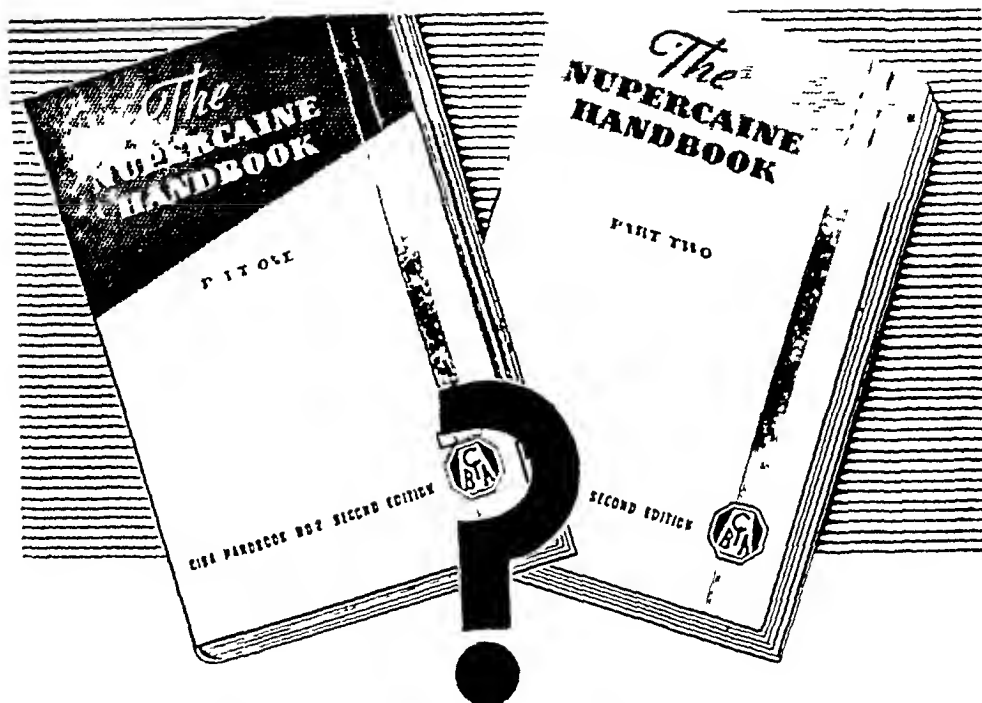
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British Journal of Anæsthesia

VOL XX, No 3

JANUARY 1947

THE CENTENARY OF ETHER

THE one hundredth anniversary of the use of ether at a surgical operation was commemorated in London in several ways. At the Royal Society of Medicine the Historical Section devoted a meeting to the subject. The President of the Section, Dr Charles Singer, discoursed learnedly of the efforts at narcosis from the earliest times, tracing progress through the ages up to the present day. Miss Barbara Duncan outlined the history of anæsthesia by inhalation, and Dr Joseph Blomfield described modern development of anæsthetic practice up to 1935. After the meeting the company were taken by motor charabanc and the courtesy of Dr Arthur Underwood, the Director, to the Wellcome Institute of Research. There, after a sumptuous tea, they were enabled to inspect an exhibition got together by Dr Underwood demonstrating the progress and development of anæsthetic drugs, apparatus and practice from the far past up to to-day.

At University College Hospital on a subsequent day Dr Massey Dawkins, Anæsthetist to the Hospital, read a comprehensive paper which showed amongst other things the pioneering work which the institution had played in anæsthetic practice from the time of John Snow through the days of Dudley Buxton and Felix Rood. As an exhibit there was to be seen the small wooden operating table on which had lain the patient while Liston performed on him the first operation to be done in London under the influence of ether. Dr E. A. Barton, whose father had been present when Liston operated, recalled the parent account of the screams and cries which accompanied a surgical operation before the days of anæsthesia.

TREATMENT-OF HIRSCHPRUNG'S DISEASE BY SPLANCHNIC BLOCK

By J SCHOLEFIELD, F R C S

Surgeon, West Middlesex County Hospital, Isleworth

and E CHIVERS, D A

Senior Anaesthetist, West Middlesex County Hospital, Isleworth

HIRSCHPRUNG'S Disease or Megalocolon is a condition characterized by symptoms and physical signs which follow a fairly constant pattern, but whose ætiology is still not wholly proven, and whose treatment is far from satisfactory

The disease, usually seen in infants and children, may appear in adults, presenting a similar clinical picture, though usually of a milder degree. Boys are more often affected than girls. Briefly the typical history is that of a male child suffering from obstinate constipation, with periodic attacks of diarrhœa. Vomiting may occur, growth is stunted, and the child is of sallow complexion. The abdomen is grossly distended. Diagnosis is confirmed by a Barium enema, or a Barium meal with a follow-through.

Pathology

The dilatation and hypertrophy are confined usually to sigmoid and descending colon, there is no organic obstruction distal to the affected gut, the gut below the recto-sigmoid junction being normal in calibre. The hypertrophy results from an increase in the circular muscle fibres, this at first being the chief change, later ulceration of the mucosa from stagnant fæces leads to infection and secondary fibrosis. It is obvious that any treatment likely to lead to normal bowel calibre must be performed before secondary changes take place, i.e., in the very young.

Ætiology

Most authorities regard the cause of megalocolon as being

due to neuromuscular incoordination, an imbalance between the sympathetic and parasympathetic taking place, leading to overaction of the sympathetic.

That this theory is probably correct is suggested by the results of various sympathectomy procedures and by the occasional association with other conditions, such as megalo-ureter, whose ætiology is regarded as having a similar basis

Treatment

In the earliest stages this is essentially medical, liquid paraffin and regular daily enemata, distressing both to mother and child, being its chief features. Also various drugs, both parasympathetic stimulants and paralysants, have had their sponsors

Surgical Treatment

Excision of the affected bowel was widely practised prior to any form of operation on the sympathetic system. This procedure is still performed but must inevitably carry a very high mortality

Sympathectomy

Various procedures have been put forward, each with its own peculiar disadvantages. Left lumbar ramisectomy, lumbar II to lumbar V, was first advocated, and this was subsequently widened into lumbar ganglionectomy, with resulting loss of sympathetic control to the vessels of the lower limb

Presacral neurectomy with prolongation upwards to include the origin of the inferior mesenteric artery from the aorta, and excision of the inferior mesenteric ganglion was the next to be tried. This operation is prone to cause sterility, by failure of ejaculation, a serious complication, especially as males predominate in this condition

Spinal Analgesia as a form of treatment was first suggested by Stabins, Morton and Scott in 1935¹. Previously this had been used as a preliminary test as to the probable efficiency of a sympathectomy. They found that the mere giving of a spinal anæsthetic would restore the normal peristaltic mechanism of the bowel. Hawksley² found that out of twelve cases so treated

eleven showed marked improvement. This avoided the dangers of an open operation in these children, but there still existed the dangers associated with a high spinal anaesthetic. In order to be certain that all splanchnic fibres are included, a high spinal block to the level of D4 has to be performed.

In view of the reported favourable results following spinal analgesia, the authors decided to try the effects of splanchnic block on these patients, as this seemed to have some advantages over spinal block.

The fall of blood-pressure following splanchnic block is much less than that following a high spinal anaesthetic, and other complications which may follow splanchnic block are fewer and less serious than those which may follow spinal block.

The technique which was used in this series, Kappis' method of posterior splanchnic block, may on occasions present some difficulties, especially in children, where the landmarks cannot always be identified with ease, but it is frequently less difficult to perform than the lumbar puncture necessary for the spinal anaesthetic.

In this series Anathaine or Amethocaine Hydrochloride with Adrenalin was the drug used, the strength and quantity of the solution varied with the age and weight of the patient.

CASE I Adult male aged 46 years

Splanchnic block was performed under local analgesia. 80 cc of 1/4000 Anathaine Solution were injected each side. There was no fall of blood-pressure following the injection and the patient's general condition remained satisfactory. He was treated with daily enemata and purgatives. On the 14th day after the splanchnic block, his bowels acted without an enema, after this his symptoms were entirely relieved and his bowels acted regularly each day. Two years later he was readmitted to hospital for a partial gastrectomy. The operation was successfully performed under Regional Analgesia, at operation his colon still showed hypertrophy and dilatation. He remained symptom-free during his stay in hospital, and also after his discharge.

When he was last seen, $3\frac{1}{2}$ years after the splanchnic block had been performed, he was in good health and showed no symptoms of his megalocolon

CASE 2 Female aged 17 years

Splanchnic block was performed under local analgesia 80 cc of 1/4000 Anathaine Solution were injected into each side. She experienced no fall of blood-pressure or other symptoms following the block. Daily enemata were given, and on the 11th day after splanchnic block her bowels acted without an enema. She was discharged symptom-free, and has remained so for 3 years.

CASE 3 Female aged 11 years

Splanchnic block was performed under light general anaesthesia 50 cc of 1/1000 Anathaine Solution were injected each side. Her blood-pressure dropped from 120/100 to 110/90 within half an hour of the completion of the splanchnic block, but rose rapidly after that. She showed no other symptoms, and her condition gave no cause for anxiety. After daily enemata and purgatives her bowels acted on the 12th day without an enema. She was discharged symptom-free, and has remained so for 3 years.

CASE 4 Male child aged 4 years

Splanchnic block was done under a general anaesthetic 11 cc of 1/2000 Anathaine Solution were injected each side. He showed no fall of blood-pressure or other symptoms, and was given daily bowel wash-outs. On 11th day, as his bowels had not yet acted without an enema, the splanchnic block was repeated under a general anaesthetic. On this occasion 10-cc of 1/1000 Anathaine Solution were injected. Recovery was uneventful, four days later his bowels acted without an enema and his abdominal distension was considerably relieved, he was discharged from hospital one week later, his constipation entirely relieved. He has remained symptom-free for 18 months.

CASE 5. Male infant

Splanchnic block first performed under a general anæsthetic at age of 8 months, 1/6000 Anathaine Solution was used, but the result was unsatisfactory. He was a weak, undersized child, and was retained in hospital for many months, receiving treatment for various ailments unassociated with megalocolon. At the age of 2 years the splanchnic block was repeated under a general anæsthetic, 10 cc of 1/2000 Anathaine Solution were injected each side. He showed no ill effects following the splanchnic block, and was given daily bowel wash-outs. The block, however, proved a failure and his constipation was not relieved, so 21 days later the block was again repeated under a general anæsthetic. 10 cc of 1/1000 Anathaine Solution were injected each side on this occasion, and he showed no immediate ill effects following the injection. Four days later, in spite of daily bowel wash-outs, he was still constipated, and started vomiting—he also showed marked abdominal distension. After several large, hard faecal masses had been removed from his colon his condition improved, the abdominal distension became less, and he stopped vomiting. From this time his bowels acted without an enema at irregular intervals, but though his condition had improved the results of the splanchnic block did not appear satisfactory. At this stage he developed measles and was transferred to an isolation hospital. In view of the apparent failure of the block it is intended to readmit him at a future date for further treatment.

The treatment of four of the five patients in this series has proved satisfactory. These patients have now been symptom-free from 18 months to 3½ years. The failure of the splanchnic block in Case 5 was probably due in part to the difficulties in technique, in this undersized child, also probably to the fact that the correct strength and quantity of Anathaine Solution necessary to give a satisfactory result has not yet been injected in this instance.

In spite of the daily enemata and purgatives given to these patients, no result occurred until between the 11th and 14th

day after the splanchnic block, and as yet there seems to be no obvious reason for this

The authors consider that as splanchnic block, as a method of treatment for Hirschsprung's Disease, has proved satisfactory in these patients, and as it appears to have fewer dangers and complications than most other forms of treatment used for this condition, it is worth while trying it before using more drastic forms of treatment

SUMMARY

The ætiology, pathology and treatment of Hirschsprung's Disease are discussed, and the splanchnic block is suggested as a method of treatment for this condition. A summary of five cases treated by this method is given and some advantages discussed

REFERENCES

- ¹ Stabin, L J, Morton, J J, Scott, W P M *Amer Journ of Surg*, 1935, xxvii, 107
- ² Hawksley, M *Brit Journ of Surg*, 1944, xxxi, 245

AMETHOCAINE OR NUPERCAINE

By E. FALKNER HILL, M D , D A

THERE are fashions in medicine as in other things, as all doctors will agree who have lived long enough. To give but one example. When we gave up the Clover's ether inhaler and took to "open ether" it was not long before we began to cover the gauze mask with towels, gamgee, etc., to conserve the patient's CO₂, a tacit acknowledgment that the Clover had its advantages. Just now it is the fashion to disparage spinal anæsthesia. The disparagement varies from the illogicality of attributing to spinal anæsthesia meningitis, which was admittedly due to faulty sterilization of instruments, to authoritative but vague statements about the inevitability of certain undesirable after-results. It is to be noticed that the authors of these criticisms are for the most part either men who do not use spinal anæsthesia or, if they do, use light Nupercaine. It may be that there is something peculiarly obnoxious about light Nupercaine, I don't know, I never use it. If there is, then it may account for the "inevitability of certain undesirable results."

In the comparison I am about to make between heavy Amethocaine and light Nupercaine, seeing I have no experience whatever of light Nupercaine, I must of necessity take the opinion of one who is well known and universally respected for his knowledge and experience of spinal anæsthesia. It must be admitted that, in so far as Professor Sebrechts allows emotion to interfere with the clear cold light of pure reason, emotion or prejudice, if one may use such a word in connection with so respected a name, will be all on the side of the drug he uses now, after all his experience with others, and this drug is Nupercaine and used in light solution. He condemns the use of heavy Nupercaine as causing an undue amount of headache.

Let us see what he says about Nupercaine used in light

solution I quote from two articles which appeared in the *British Journal of Anaesthesia* in October 1934 and July 1935 Here are the most important points

1 Percaine, a quinoline derivative, has a very strong impregnating power, it is a real "mordant" It has the same qualities as Tutocaine as regards its action on the sensitive and orthosympathetic fibres with the advantage of an appreciably longer duration, but *the factor which characterizes it and gives it an entirely special place in the series of anæsthetic agents is the intensity and duration of the blockage of the motor fibres*

2. This (paralysis of all the intercostal nerves) is a condition frequently seen when one uses Percaine, which, as we have said, seems to have a special affinity for the motor fibres

3 In such cases the patient exhibits that *slight degree of cyanosis which is so characteristic of Percaine anæsthesia* It is generally necessary to watch the patient because the diminution of the amplitude of the respiratory movements is a causal factor of circulatory hypotension

4 In the normal human organism, as a matter of fact, every deep movement of inspiration causes a vacuum in the thorax, this vacuum does not serve solely to fill the lungs with air, but in addition causes the blood to rise into the vena cava in order to ensure the filling of the heart The physiologists have taught us that the filling of the heart is a stimulant that is necessary to start the cardiac contractions The suppression of the inspiratory movements of the thorax immediately causes the stoppage of the aspiration of the venous blood and the action of the heart weakens This is how the diminution of the respiratory amplitude is a cause of hypotension

5 The anæsthetic agent which blocks the anterior roots of a high segment of the medulla puts out of action not only the motor fibres, but also those of the vasoconstrictor orthosympathetic nerve which accelerate the heart and promote the adrenalin secretion

Nemo omnibus horis sapit, but if we were it would matter not at all what solution we used, as, however, we are not, it is better to choose that drug which gives us the greater margin of safety

The correct estimation of the life worthiness of a patient is one of the most difficult tasks that the physician has to face, and the nice gauging of the dose of a spinal anæsthetic which depends on that estimate is therefore a matter of great delicacy, calling for all the judgment and experience at our command. The evidence before us to-day is to the effect that a spinal anæsthetic can cause the death of a reasonably healthy patient only by paralysing respiration. That it may be a factor in causing the death of a patient who is near to it already by, for instance, bringing about a fall of blood-pressure without paralysing or even weakening respiration is probable. It will not kill a healthy patient in this or in any other way except by paralysing respiration. It is perhaps doubtful if all authorities would go so far, but what is not in doubt at all is that they all agree that the paralysis or even the weakening of respiration is a serious event in the course of a spinal anæsthesia, one which demands immediate counter-measures. It is a fair thing, then, to take as the criterion or test of a technique of spinal anæsthesia the effect of that technique, that anæsthetic on respiration. What does Professor Sebrechts say about Percaine? "The factor which characterizes it and gives it an entirely special place in the series of anæsthetic agents is the intensity and duration of the blockage of the motor fibres." Again, "This paralysis of all the intercostal nerves is a condition frequently seen when one uses Percaine." And once more, "That slight degree of cyanosis which is so characteristic of Percaine anæsthesia." Here, then, we have an anæsthetic which owes its position among anæsthetics to the intensity and duration of its action on the motor fibres, to its paralysis of all the intercostal nerves, to a state of anæsthesia characterized by "a slight degree of cyanosis." If the weakening and paralysis of respiration is the danger that we particularly wish to avoid, as it is, then in all these particulars Percaine is peculiarly unsuitable. This paralysis of all the intercostal muscles "so frequently seen when one uses Percaine" is the cause of that diminution of amplitude of respiration which Professor Sebrechts cites as the cause of hypotension.

Again Professor Sebrechts says, "The anæsthetic agent which

blocks the anterior roots of a high segment of the medulla (does he mean spinal cord?) puts out of action not only motor fibres, but also those of the vasoconstrictor orthosympathetic nerve which accelerate the heart and promote adrenalin secretion." This, then, is a very strong argument for the use of a heavy solution rather than a light one. If when using a heavy solution we find the anæsthesia higher than we intended, that is to say we have got more posterior roots involved, it by no means follows that the corresponding anterior roots are affected. Thus I have the blood-pressure record of a patient whose anæsthesia extended to the skin over the shoulder joints, yet he could breathe in comfort, could move his arms, and his blood-pressure was actually higher throughout the operation than before it started. It is quite evident that some of the upper dorsal anterior roots were still unaffected by the anæsthetic at a time when the posterior roots of several cervical nerves were deeply anæsthetized.

For the last eleven years I have been using a 1 per cent solution of what is known as Amethocaine *alias* Pontocain *alias* Decicain of a specific gravity of 1.026. Amethocaine does not last as long as Percaine, I believe, but a suitable dose should give two hours. I have often seen it last longer, but in every other respect it appears to be superior to light Percaine. That Professor Sebrechts realizes that he is dealing with a potentially dangerous injection is evidenced by the time he takes and the careful observations he makes when using it, but if such an experienced surgeon requires to take all these precautions surely those younger and less experienced anæsthetists in this country who use light Percaine should do so, too. I have never heard of such. Can it be that fools rush in where angels fear to tread?

To sum up, then, the advantages of Amethocaine

- 1 It does not spend its power especially on the motor fibres
- 2 Used in heavy solution any accidental excess will spend itself chiefly on posterior roots, a matter of no moment, in contrast to an excess dose of a light solution which spends itself particularly on anterior roots. Further, if the light solution be that of Nupercaine not only is the fall of blood-pressure excessive

by the paralysis of the vasoconstrictors of the anterior roots but intercostal respiration is paralysed due to the "intensity and duration of the blockage of the motor fibres" This is another cause of low blood-pressure by the diminution of the amplitude of respiration

3 Amethocaine has a very powerful action on posterior roots as evidenced by the fact that many patients are less aware of what is going on when under Amethocaine than when under Nupercaine (heavy)

4 Amethocaine is not characterized by that slight degree of cyanosis which is so characteristic of Nupercaine

5 The one sole advantage that Nupercaine seems to possess is that it will last longer But should an operation under spinal anæsthesia last longer than two hours?

The 1 per cent Amethocaine solution was originally made for me by the Manchester Royal Infirmary dispensary, but of late Messrs Duncan and Flockhart have taken it over

SPINAL ANALGESIA, WITH SACRAL ESCAPE*

By DR. K. E. MADAN, M D , D A , D O M S , F. I. C. A , *Lecturer
King Edward Medical College, and Chief Anæsthetist,
Mayo Hospital, Lahore*

IN the ordinary type of spinal analgesia, whether induced by hypo, hyper, or isobaric solution, the result is a complete paralysis of all sensory and motor nerves from the toes right up to the segment desired. Hence in an abdominal operation, besides the abdominal area all the lumbar and sacral nerves get paralysed. It seems sometimes unnecessary that all the lumbar and sacral nerves be involved when the operation is on a part of the abdomen, and it is also undesirable, as there is often retention of urine, and so the patient is unable to pass urine and requires catheterization. Sometimes this catheterization requires to be repeated for several days as the spinal centre for micturition, situated in the sacral part of the spine, gets paralysed. This effect on the spinal micturition centre is mostly temporary, but is sometimes more pronounced by certain toxic drugs like Stovaine Anaethaine with 10 per cent glucose, heavy Nupercaine, particularly if a bigger dose than necessary is injected and if alcohol has been used to lighten the specific gravity of the spinal solution, because alcohol has a destructive action on nerve centres and tissue, as pointed out by me in the *British Medical Journal* of 6th November, 1945, under Stovaine Analgesia.

It is now a known fact that a few cases have occurred of permanent urinary and defecation derangements and the patients have sometimes sued or cursed the surgeon or anæsthetist concerned for their spinal anæsthetic. This is one of the reasons why certain operators prefer general to spinal anæsthesia, as they had such bitter experience of spinal anæsthesia. But the thing that prompted me to work out this method of sacral escape is that

*This paper was read before the Ether Anæsthesia Centenary Celebration Meeting, Bombay, October 1946

I have seen at times male patients after operations, in the free surgical wards, in severe agony due to retention of urine, and the nurse or a lady house surgeon present there would not catheterize, and the patients waited very anxiously till a male house surgeon came up for his rounds and relieved the patient by passing a catheter. Such patients were in a condition of severe psychic shock, with beads of cold sweat on the forehead and anxious crying look, although there was no other post-operative complication. This retention of urine is therefore an undesirable and unnecessary complication of spinal analgesia.

I have, therefore, for over a year now, successfully modified the technique of administering spinal analgesia, so as to allow all the sacral nerves to escape. The patient is put in a lateral position with the thighs well flexed and touching the abdomen.

With a hyperbaric or heavy solution, even before the spinal injection is given the pelvic end of the table is raised to 15 degrees, and also the head end to 15 degrees, with a pillow under the head and neck. After thus arranging the pelvic and head ends of the table, the position of the table appears to be like a broad letter V (Plate No. I). Now, the whole table is slightly tilted to Trendelenburg position. These adjustments of the table are quickly made by the two wheels that are provided at the cephalic and the caudal ends, and also by the arrangement for tilting the whole table to Trendelenburg position. The lowest or most dependent part of the spine is now the region of the 3rd lumbar, or 3rd and 2nd lumbar. The object of keeping the thighs well flexed and raising the caudal end of the spine is to straighten up the lower end of the spine and entrap the solution in the mid-lumbar and lower-lumbar region, and prevent it entering the sacral concavity, so that all the sacral nerves and the sacral centre of micturition escape.

In *Surgical Physiology*, by J. Nash, it is stated "since micturition can be carried out naturally after ablation of hypogastric plexus, it is clear that only the sacral supply to the bladder is essential for micturition." Now the hypogastric nerves coming from the lumbar ganglia are paralysed in spinal analgesia, but

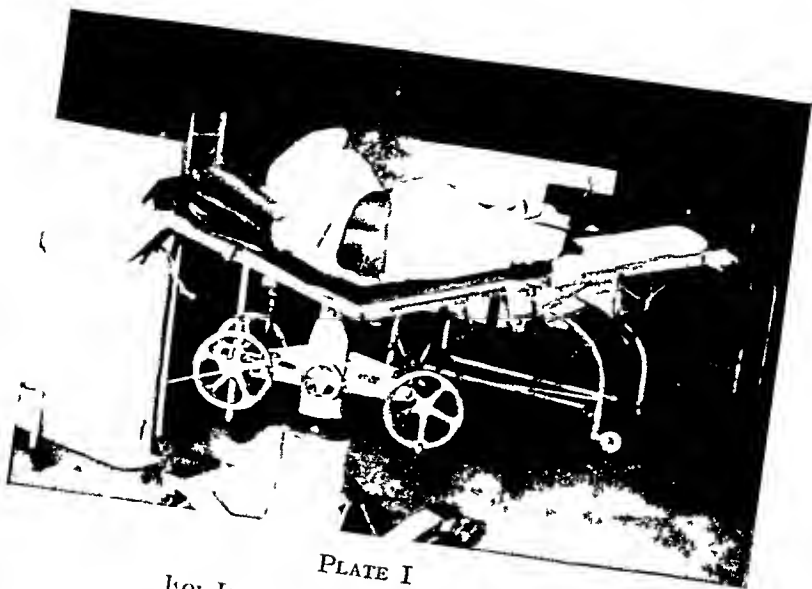


PLATE I
For Injection of Heavy Solution



PLATE II
After Injection

if the sacral nerves escape, then the nervi erigentes or the pelvic nerve which arises from the sacral segments escape, and so the act of micturition can be performed normally by the patient (Diagram No 1)

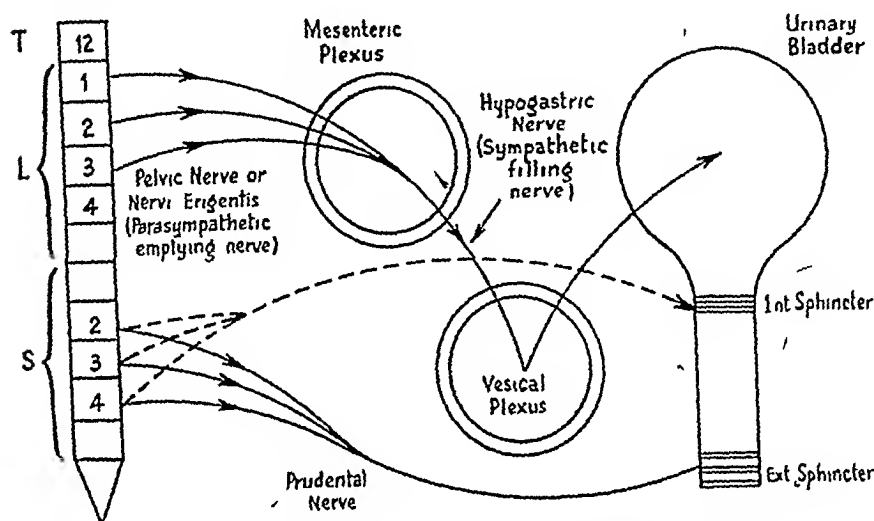


DIAGRAM NO 1 AUTOMATIC CONTROL OF BLADDER

The injection is given slowly without any force or barbotage. After the injection, the patient is turned on the back with both thighs still well flexed and almost touching the abdomen for about 3 minutes (Plate No II), after which the limbs are straightened. The quantity of solution injected is only the necessary minimum.

With a hypobaric or light solution, if the table is immediately put in the Trendelenburg position after the spinal injection, as is commonly done, the sacral nerves cannot escape, because the solution remains caudalwards, but if before the injection is given the patient is so put that the highest part of the spine and body is kept at about the 5th dorsal, and the thighs well flexed on the abdomen with patient in lateral position, and the head and neck kept low, the light spinal solution, which should be warmed, will not collect down in the sacral concavity but will ascend cephalwards.

Further procedure depends upon whether the effect of spinal

analgesia required is only for one side of the body, i.e., unilateral, or hemi-lateral, or a bilateral effect. The former, or unilateral, is advantageous for one-sided limited operations, e.g. hernias, etc., because there is less fall of blood-pressure, whereas the usual bilateral effect is good for laparotomy and operations on the middle of the abdomen. For producing a unilateral analgesia it is necessary to maintain the lateral posture, with the affected side high in cases of hypobaric or light solutions, and the non-

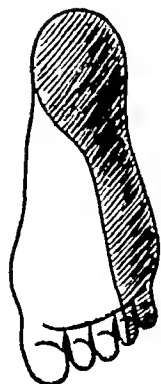
affected side resting on the table. This position is maintained till the solution is fixed, i.e. 10 to 15 minutes, and then the patient is put on his back.

For producing complete bilateral analgesia of the abdomen with light solutions the patient is first put prone on his face and stomach to soak the posterior roots for 3 minutes, and then is turned on his back to soak the anterior roots, but to secure the escape of sacral nerves the thighs must be kept well flexed for another 3 minutes and thereafter the lower limbs are straightened.

This method is useful in abdominal operations above the diaphragm. The head and neck are kept low with light solutions and the table is only gradually tilted to the Trendelenburg position.

Thus the escape of sacral nerves is successfully obtained

Shaded areas
show presence
of sensation



Sole of foot

Posterior surface of
lower limb

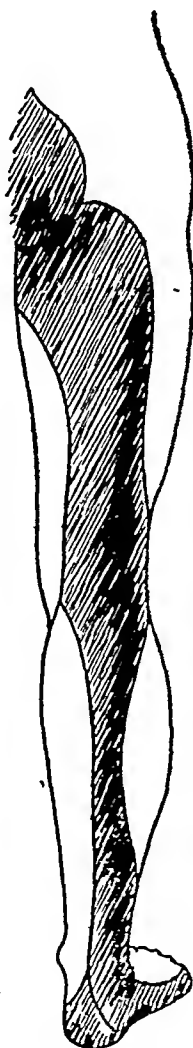


DIAGRAM No 2

with either unilateral or bilateral type of analgesia and with heavy, light, or isobaric solutions

The test of the success of this method of sacral escape is that the sensations over the perineum, scrotum and penis in the male, and vulva in the female, should be present, as tested by a pin, but as the genitofemoral nerve which comes from the lumbar nerves also supplies the scrotum, etc., if it is sometimes involved, the sensations may be lost, but certain areas on the posterior aspect of the lower limbs, where there is cutaneous distribution of the sacral nerves, remain sensitive, as tested by a pin (Diagram No 2, in which shaded area shows presence of sensation)

In conclusion, this method has the following advantages.

- 1 As the sacral nerves are not paralysed, the important sacral centre of micturition, which is innervated by these nerves, escapes, and so the micturition reflex remains unaffected

- 2 The post-operative period is comfortable inasmuch as there is no painful distention of the bladder, and therefore there is no need of catheterization, which may otherwise be needed, sometimes repeatedly, and which may lead to pain and infection

- 3 There is less trouble for the overworked house-staff of the hospital

- 4 As there is presence of sensation in the saddle area and also certain portions of the posterior aspect of the lower limbs, where also there is anatomical cutaneous distribution of the sacral nerves, the patient cannot inadvertently be burnt by a hot-water bottle over these areas

- 5 For Cæsarean sections done under spinal Anæsthesia, if by this method the sacral escape is allowed to take place, then in addition to the above-mentioned advantages the tone of the uterus is better maintained, good contractions occur, and so loss of blood is diminished.

THE MANCHESTER AND DISTRICT SOCIETY OF ANÆSTHETISTS

THE desirability of forming a Manchester Society of Anæsthetists had been long obvious to some of us. The circumstances, however, had not been propitious. The credit of at last translating thought into action is due to Drs Marson and Hunter. As the result of enquiries which they made they came to the conclusion that the opportune moment had arrived, and so sent out the following letter.

Dear Dr ,

Many of us here in the Manchester area think that the time is ripe for the formation of a local Society of Anæsthetists. You are therefore cordially invited to attend a meeting of anæsthetists to be held in the Board Room of the Manchester Royal Infirmary on Thursday, November 29th, at 5.30 p.m. Dr E Falkner Hill, Senior Anæsthetist to the Infirmary, has kindly consented to take the chair.

At the meeting you will be asked to consider the following

- 1 The desirability of the formation of a Manchester and District Anæsthetic Society
- 2 If agreed on, to proceed to elect officers and committee for such a Society
- 3 To discuss the relations of such a Society to existing organizations

If you are unable to attend we should be very glad to receive your observations, in order that they may be presented to the meeting.

Yours faithfully,

(Signed) E. A. MARSON

A. R. HUNTER

Resulting from this circular letter a meeting was held at the Manchester Royal Infirmary on November 29th, 1945, and to our great surprise thirty-two anæsthetists attended.

Dr E Falkner Hill presided, and he formally put it to the meeting that an Anæsthetic Society should be formed, and this was agreed to unanimously

A temporary committee was appointed with the object of drawing up rules and defining the functions of the Society and its relationship to the Association of Anæsthetists of Great Britain and Ireland. This committee met on several occasions, and a further meeting was held on February 21st, 1946, when the title of The Manchester and District Society of Anæsthetists was adopted and the Rules were passed and accepted

In view of the fact that very strong support had been received from outside anæsthetists, from places as far away as Blackpool, Preston, Blackburn, Nelson, Rochdale and so on, it was felt that meetings should be arranged to combine a meal as well as the paper, so that members coming from a distance should not have the necessity of searching for a meal after coming a long journey, and accordingly the Society now meets four times a year, having a supper first at 7 o'clock and a paper read by one of the members at 8.15

The original committee was as follows

President Dr E Falkner Hill (Royal Infirmary)

Secretary Dr. E. A. Marson (Ancoats)

Treasurer Dr A. R. Hunter (Royal Infirmary)

Council Drs H. E. Barlow (Crumpsall Hospital), H. J. Brennan (Christie Hospital), J. C. Nicholson (Booth Hall), C. E. Sykes (Withington Hospital), R. E. Williams (St Mary's Hospital), F. C. Simpson (Blackburn Royal)

At this meeting the newly-elected President, Dr E Falkner Hill, gave a very interesting address entitled "The Evolution of Anæsthesia in Manchester As I Have Seen It, 1900-1945"

Three other meetings have since been held, papers being read by Dr J. C. Nicholson on "Anæsthesia for Penetrating Chest Wounds", two papers given on "Curare" by Dr H. J. Simmons of Manchester and Dr A. J. Gray of Preston, and the third one by Dr D. Culbert of Nelson, who talked on "Trilene"

The attendance has been very good, and at the last two meetings forty-nine anæsthetists have been present on each occasion. Our circle seems likely to grow a little, as at the last meeting we had anæsthetists from as far apart as Lancaster in the north and Derby in the south.

The present membership numbers sixty-three, and all have expressed their agreement that the Society is filling a real need in the area. The attitude of the Society is that it shall be entirely non-political, and that it shall be for purely scientific and social purposes, and that anybody, whether attached to a hospital or not but whose prime interest is in anæsthetics, shall be eligible for membership.

THE MANCHESTER AND DISTRICT SOCIETY OF ANÆSTHETISTS

OFFICERS AND COUNCIL

1946-1947

President DR E FALKNER HILL

COUNCIL

DR H E BARLOW
DR H J BRENNAN
DR J C NICHOLSON

DR F C SIMPSON
DR C E SYKES
DR R E WILLIAMS

Honorary Secretary
DR E A MARSON,
16, Milton Crescent,
Cheadle,
Cheshire.

Honorary Treasurer
DR A R HUNTER,
28, Grange Avenue,
Cheadle Hulme,
Cheshire

RULES

- 1 The Society shall be called "The Manchester and District Society of Anæsthetists"
- 2 Its objects shall be (a) To spread the knowledge and enhance the practice of anæsthesia (b) To afford a medium for the exchange of ideas (c) To promote harmony and good fellowship among anæsthetists

3 Anyone on the staff of a hospital as anæsthetist or whose prime interest is in anæsthetics may be elected a member of the Society

4 The affairs of the Society shall be managed by a Council consisting of the President, Secretary, Treasurer and six (6) other members

Council meetings shall be held at least twice in each year, but the Council may meet more frequently, if advisable

A Council meeting may be summoned upon the request in writing of two members of Council with consent of the President. Seven clear days' notice to be given

The Council shall prepare a report for the Annual General Meeting.

5 The President, Treasurer and Secretary shall be elected annually at the General Meeting, but shall be eligible for re-election, except that the President shall not hold office for more than two years in succession

The six ordinary members of Council shall hold office for three years. Two shall retire annually and shall not be eligible for re-election until after the lapse of one year

Note Of those elected at the First General Meeting two shall retire at the end of the first full year commencing in April, 1946, and two each year afterwards. Any candidate may be submitted for re-election to these offices if his name, duly proposed and seconded, has been sent to the Secretary at least one month before the Annual General Meeting. Should other vacancies occur, the Council shall have power to co-opt a member of the Society to fill such vacancies until the following Annual Meeting

At a meeting of the Council, five shall form a quorum

6 The Treasurer shall receive subscriptions, pay all bills, and present the accounts yearly to the Council and to the Annual General Meeting. He shall be authorized to sign cheques on behalf of the Society

The accounts shall be audited by two members of the Society appointed by the Council

7 The Secretary shall summon all meetings, shall prepare Agenda, and shall keep Minutes of the proceedings

A copy of these Minutes shall be sent to each member of the Council. He shall send, not less than one week before the Annual General Meeting, to each member of the Society a list of candidates for the various offices, balloting papers and Agenda papers as may be necessary

8 The Annual General Meeting shall be held in April and at least three ordinary Meetings during the year. Some meetings may be held in towns other than Manchester

9 Ordinary meetings shall be held for the purpose of (1) the election of new members, (2) any other business, (3) the reading of papers and discussions thereon

10 New members may be elected at any ordinary Meeting on the nomination of the Council. Any member of the Society may by letter to the Secretary not less than one month before an ordinary Meeting propose the name of a candidate, who shall be personally known to him and he shall submit reasons in support of his proposal. The proposal shall be seconded by a Member of the Council

The list of candidates so nominated shall be sent by the Secretary, not less than one week before an ordinary Meeting, to each member of the Society, who shall record his votes and shall return the paper to the Secretary at, or before, the Meeting. Scrutineers shall be appointed by the Meeting to count the votes and the result shall be announced to the Meeting. Two adverse votes shall reject the nomination.

The list of candidates proposed for election to the Council shall be similarly circulated for voting. The election shall be conducted by ballot and the result announced at the Annual General Meeting.

11 Visitors, by permission of the President, may be introduced by members. Their names shall be entered into a book provided for the purpose. They may take part in discussions subject to the same rules as members but they may not vote.

12 The subscription shall be £1 10s 0d a year payable on July 1st (This includes 4 meals).

The membership of anyone whose subscription is more than one year in arrears lapses.

13 Notice of any proposal to amend and alter the existing rules, or to pass new rules, must be sent to the Secretary not less than one month before the next ensuing ordinary Meeting and must appear on the Agenda of the said Meeting in the form of a written proposal. The adoption of such a proposal, in order to be effective, shall be passed by a majority of two-thirds of those present and voting.

ANÆSTHESIA AT MCGILL UNIVERSITY, MONTREAL

A department of anæsthesia has recently been set up at McGill University. Its main objectives are (1) Improvement of teaching of anæsthetics to the undergraduate, (2) Enhancement of opportunities for learning anæsthesia by the internes of hospitals connected with the University, (3) Maintaining a three-year diploma course in anæsthesia for those graduates in medicine who desire to become complete specialists, and (4) The development of investigation in anæsthesia, in the way of interrelationship in the clinic and in the laboratory and, also, in an interdependent fashion with the University's other departments.

Missing Back Numbers

OWING to the Editor's over-generosity in supplying back numbers to libraries and institutions he finds himself without a complete set for reference. He would be most grateful if any of the following can be spared, and is willing to buy any that are offered.

Vols VI, VII, VIII, all numbers and title pages,
Vol IX, Nos 1, 2, title and index, Vol X, Nos
1, 2, Vol XI, Nos 1, 3, 4, title and index, Vol
XII, Nos 1, 3, 4, Vol XIII, Nos 2, 3, Vol
XIV, title and index, Vol XV, No 1

CURARINE CHLORIDE AS AN ADJUNCT TO GENERAL ANÆSTHESIA

By E ASQUITH, M R C S , D A

Clinical Assistant in Anæsthetics, Royal Infirmary, Sheffield
Late Tutor in Anæsthetics, University of Bristol

CRUDE curare first became known to science when it was mentioned by Hakluyt in 1594, but it was not until 1935 that Mr Harold King, D SC , F R S , of the National Institute for Medical Research, described the isolation of d-tubocuraine chloride. Messrs Burroughs Wellcome and Co , working to King's specification, produced the first commercial supply of pure crystalline d-tubocuraine chloride and marketed it under the name of curarine chloride. It was a dry crystalline powder in a wax-sealed glass phial. The same firm now supply it in a sterile liquid form containing 10 mgm of curarine chloride per ml and register it under the name "Tubarine."

Prior to the introduction of Tubarine, this crystalline powder had to be sterilized and dissolved in a solvent before use. It was felt that although the powder could be autoclaved, provided all moisture was excluded, and then dissolved in sterile saline or distilled water the risk of future contamination of whatever remained of the solution was not negligible and therefore a self-sterilizing solvent would be more advantageous.

Glycero-Alcohol¹ (Glycerin 333, Aq Dist 146, 95 per cent Alcohol, 580 parts by volume) was chosen because it had been used as a solvent for various drugs for a number of years at the Bristol Royal Infirmary and no adverse phenomena had been noted.

The solution was made up to contain 10 mgm of curarine chloride per ml. One particular sample was subjected to all the variations of temperature which could be expected under normal working conditions, and when assayed after being in

solution for 29 weeks it was found to have "Practically no loss in potency" Culture of several samples were all sterile

All patients in this series were premedicated with Omnopon gr 1/3 and Scopolamine 1/150, reduction being made for the aged and frail patients The anæsthetic agents were used as follows Pentothal and Cyclopropane, Pentothal and Nitrous Oxide, Cyclopropane, Nitrous Oxide, Oxygen and Ether or Trilene, and Ethyl Chloride and Ether from an Oxford Vaporizer

For all abdominal cases 10-15 mgm of curarine chloride were given intravenously about two or three minutes before the peritoneum was opened, and if the abdominal relaxation was not perfect further 5-10 mgm were added until the necessary abdominal relaxation was obtained Additional doses of curarine chloride of 10-15 mgm were added during the operation whenever further relaxation was required, and a final dose, if necessary, of 5-15 mgm was given for the closing of the peritoneum

Ideal conditions for intubation were produced by slowly injecting intravenously a mixture of 15 mgm of curarine chloride and 0.5 gr of Pentothal With Intocostin¹ (brand of curarine chloride supplied by E. R. Squibbs and Son of New York), Tubarine or curarine chloride² dissolved in sterile Aq. Dist. or saline, a precipitate forms on adding it to Pentothal, this precipitate will redissolve on shaking the mixture, although sometimes not very readily With Glyco-Alcohol as the solvent for the curarine chloride no precipitate was noted on mixing

Anæsthesia was maintained in Plane 1 or upper Plane 2 (Guedel) throughout the operation During the series of cases induced with Pentothal and maintained with Nitrous Oxide and Oxygen an effort was made to ascertain the duration of action of curarine chloride These agents were selected in preference to more powerful ones which with a slight deepening of the plane of anæsthesia cause increased muscular relaxation With Nitrous Oxide and Oxygen at a constant percentage the plane of anæsthesia would, if anything, tend to lighten, provided, of course, that the patient's condition was not deteriorating The

house surgeon would at regular intervals feel the tone of the rectus abdominis muscle and note was made of the time when tone returned. Average duration of activity of 1 mgm of curarine chloride was found to be 12 minutes or conversely in one minute the body destroys or excretes 0.83 mgm of curarine chloride.

It has been stated that the dose of curarine chloride should be reduced by $\frac{1}{3}$ when Ethcl is the anaesthetic and this was confirmed.

The power of muscle fibres to contract on direct stimulation even when curarized is well demonstrated in myomectomies. The uterine muscle will be seen to contract markedly when the myoma is being "shelled out," and due to this contraction bleeding from the cut surface of the uterine muscle has been noted to be very much less than in anaesthetics where no curarine chloride was used.

No complications were noted in this series which could be attributed to the curarine chloride. There was some increased oozing from the cut surface of the skin, but this was probably due to the fact that the blood-pressure remained constant throughout the operation, whereas it is more customary to expect some fall in blood-pressure during the long intra-abdominal operations with the deep plane of anaesthesia required. A slight increase of 5-10 mm Hg in the systolic pressure was noted in a few cases after the curarine chloride had been given and was attributed to the decreased tidal volume and hence an increased carbon dioxide level in the blood. This blood-pressure increase soon returned to normal after a manual compression of the breathing bag for a few minutes.

The general condition of the patients was superior to that normally seen after long anaesthetics, and post-operative nursing care was greatly reduced due to the rapid regaining of consciousness and co-operation, this in itself tending to decrease the chances of post-operative complications.

Vomiting was decreased in both incidence and severity.

The order of paralysis of muscles when increasing doses of curarine chloride are given is as follows: muscles innervated by

cranial nerves, muscles of the limbs, abdominal muscles and muscles of the thoracic cage and lastly the diaphragm. The dosage should, therefore, be carefully judged to paralyse only those muscles which if not relaxed would impair the operative field.

OPERATIONS

Upper abdominals

Elective	32	Partial gastrectomy	16
Emergency	19	Laparotomy	7
		Gastro-enterostomy	3
		Cholecystectomy	4
		Upper ventral hernia	1
		Nephro-lithotomy	1
		Perforations gastric, duodenal or jejunal	13
		Acute obstructions	6
			—
			51

Lower abdominals

Elective	33	Laparotomy	6
Emergency	30	Appendicectomy	23
		Hysterectomy	9
		Myomectomy	7
		Acute obstructions	9
		Ruptured ectopic	6
		Hemi-colectomy	3
			—
			63

Miscellaneous

D and C, Haemorrhoidectomy	6
Intubation Tonsillectomy, etc	6
*Prior to abdominals where further curarine chloride was used	28

* These have not been included in the total as they already appear in the list of abdominals

Types of Anæsthesia

Cyclopropane	42
Pentothal and Cyclopropane	20
Pentothal, Nitrous Oxide and Oxygen	49
Nitrous Oxide, Oxygen and Ether or Trilene	4
Ethyl Chloride and Ether (Oxford Vaporizer)	11

Respiratory complications

Major	4		
Minor	14		
		Age limits in years	13 to 78
		Average	43
Maximum duration of any anæsthetic			3½ hours
Maximum amount of curarine chloride given throughout any operation			50 mgm
Average amount of curarine chloride used per operation			24.5 mgm

SUMMARY

A new solvent for curarine chloride is described for which the following properties are claimed.

- 1 Stability of curarine chloride in the solution
- 2 Self-sterilizing
- 3 No irritant action on veins
- 4 No precipitate appears on mixing with Pentothal

Perfect abdominal relaxation was obtained in this series of 114 unselected cases, and in the 12 extra-abdominal cases ideal conditions were created for the selected operation

The use of ether in combination with curarine chloride is to be deprecated, as ether has already a curarizing action and an equally good operative field can be created with drugs less toxic than ether. If curarine chloride is used the dosage must be reduced by one-third

The power of muscle fibres to contract, even when paralysed by curare, on direct stimulation is well demonstrated in shelling out myomata and has a practical value in decreasing blood loss

Prostigmine in doses of 1-1½ mgm. intravenously was found to counteract the action of curarine chloride

Due to the minimal disturbance of the cardio-vascular system the poor risk patient seems to have a better chance of survival

The paralysing effect of curarine chloride on muscles, and hence its effect on the muscles of respiration, makes it a drug which should not be employed light-heartedly by those not well versed in its use.

REFERENCES

- 1 Martindale *Extra Pharmacopea*, -1941, Vol I
- 2 Solution assayed by Messrs Burroughs Wellcome
- 3 Shane, S M *Anæsthesia and Analg*, 1946, xiv, 256
- 4 Gray, T C, and Halton, J *Proc Roy Soc Med*, 1946, xxxix, 460
- 5 Griffith, H R *Journ Amer Med Ass*, 1945, cxvii, 642

ABSTRACTS

In an analysis of 500 obstetrical cases with continuous caudal anæsthesia the authors recommend Pontocaine because of its low toxicity and long duration of effect. Pontocaine 0.15 per cent with Suprarenin 1:200,000 in physiological saline is the selected dose. With this solution three to five hours' relief of first-stage labour pain is obtained. Motor and sensory loss in lower limbs usually disappear within three to six hours after delivery, but of 500 cases 428 were entirely satisfactory. Thirteen of the failures were due to inability to insert the needle into the caudal canal. There was no narcotization of the baby.

For carbon dioxide absorption baralzone, composed of 20 per cent barium hydroxide with 80 per cent calcium hydroxide, is recommended.

Moisture is the essential factor to give an efficient absorbent, and baralzone has an absorbent life longer than that of "high moisture" soda lime.

REVIEWS

Physics for the Anæsthetist R R MACKINTOSH and W M MUSHIN Illustrated by Miss M McLERTY pp 235
Price 30s Blackwell Scientific Publications, Oxford, 1946

The average anæsthetist has but slight knowledge of the physics underlying the practice of his craft. He knows that ether vapour is heavier than air and he is aware of the inflammability of most of the agents with which he works. That is generally about the limit of his information in this particular direction. If he desires to be better acquainted with the physics of anæsthesia this book is admirably suited to his purpose. It is clearly written and beautifully illustrated. It deals with all the essential physical facts concerning anæsthetics and anæsthesia. Many laboratory experiments made by the author and his colleagues are described in detail, experiments dealing with temperature of anæsthetic liquids and gases under varying conditions and temperatures, and pressures in cylinders.

The question of heat loss by the patient is thoroughly examined and it is shown that in the to and fro method of CO₂ absorption suggested by Winters the heat loss by the patient in this form of anæsthesia is negligible. Investigations on ether vapour pressure under a mask and of vapour from the Oxford Vaporizer show that concentrations of ether not exceeding 17 per cent can be obtained from the mask. The maximum strength given by the Vaporizer was 25 per cent. Incidentally the author states that in flying, after 30,000 feet upwards, despite the fact that the airman breathes undiluted oxygen, the difference in pressure between alveolar and venous oxygen falls. At 42,000 feet the partial pressure of oxygen to the alveoli is just enough to ensure adequate oxygenation. Above this height the partial pressure of oxygen in the alveoli is not enough to oxygenate the venous

blood and support consciousness and life. Observations on the pressure produced in syringes show how high a pressure can be obtained without undue effort by using a syringe with a small diameter, a fact of practical importance in the practice of local anæsthesia. The questions of dissolved gases, cyanosis and respiratory obstruction are among the other phenomena described and discussed. We recommend the book as a stimulating one for the practising anæsthetist to study.

Text book of Gynæcology F. H. PEEL, F.R.C.S., F.R.CO.G.,
Obstetrical and Gynæcological Surgeon, King's College
Hospital, etc. 2nd edition pp. 467, 217 illustrations
Price 21s. Wm. Heinemann, London, 1946

The chief new features of this edition are in the chapters on physiology, uterine disorders and sterility. There are new illustrations and an appendix of hormone preparations. The book remains a first-rate guide to practitioner and student in the principles and practice of gynæcology.

An Omission

In our January 1946 issue we published an article by D. M. E. Crouch, M.B., and Edith S. M. Merry, M.B. Both of these ladies should have had D.A., after their names, the omission of which we regret.

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